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A Remarkable Motor.

IN our issue of May 17 we gave some account of a most ingenious multipolar motor designed by Dr. Louis Duncan. We are now enabled to give some details of the performance of the experimental machine, which give it unquestioned place as one of the most remarkable developments of dynamo-electric machinery. The revolving brushes originally proposed have been replaced by an elaborate system of cross connections in the armature that effect the same result without the inconvenience of extra moving parts. The finished machine weighs 1,100 pounds, and in spite of the fact that its armature is solid cast iron it develops 10 horse power at the marvelously low speed of ninety revolutions per minute, and accomplishes this feat with an electrical efficiency of 92 per cent. The commercial efficiency was not measured, but as only 25 pounds of iron are subject to hysteresis, and at a comparatively low rate of reversal, the losses from this cause should be small. Constructed of wrought iron, the same motor should give about 15 horse-power at the same efficiency. The large output, high efficiency, and, above all, the slow speed of this machine, give it a unique importance both theoretically and practically. It possesses in an extraordinary degree those qualities that are most valuable for the further development of electric traction, as well as for other uses in which low armature speed is desirable.

Driving Dynamos by Friction Gearing.

WE illustrate this week the friction cone driving gear devised by M. Hamon. While for most purposes the ordinary belt does excellent service as a means of transmitting power, there are numerous cases where lack of space makes a more compact arrangement highly desirable. Frictional driving has already been tried with some success, as instanced by the central station illustrated in our last issue; and M. Hamon's plan appears to possess some merits that render it worth investigation. The plant shown is remarkably compact, and unless the wear is excessive we seem to have here found a form of gearing that will give a good account of itself in practice.

Electrician of the World's Fair.

IT is gratifying to note the vigorous moves that have been made to secure the appointment of Mr. J. P. Barrett, city electrician of Chicago, as electrical director of the World's Fair. The nomination is an excellent one, for Mr. Barrett has the strong recommendation of a wide practical experience and is, besides, a man on whom electrical interests could depend to execute his important duties without fear or favor. In a great representative exposition the selection of an electrician intimately connected with a particular interest would be most unfortunate, but we feel sure that under Mr. Barrett's administration no commercial jealousies will be permitted to injure the completeness of the electrical section, while his well-known ability as an organizer gives ample assurance of an exhibit that will be a credit to the country.

The Unit of Self-Induction.

WE sincerely hope that the suggestion embodied in the resolutions presented at the last meeting of the American Institute of Electrical Engineers will be acted upon. It is not at all a question of national pride, but one of practical convenience. There is need of a suitable name for the unit of self-induction, for this quantity is rapidly becoming important in the modern applications of electricity. The present practice is divided between quadrant and secohm, neither of which names is in accordance with the system of nomenclature used for other electrical units. We do not speak of a resistance of fifty million kilometres per second or attempt in any way to connect the names of units with their dimensions. It would be strictly consistent to call the unit of self-induction after the discoverer and first investigator of the phenomenon; and as a working name "henry" is in every way quite as convenient as ampère or coulomb or farad. The change of name would be a well-deserved tribute to the memory of a great and original thinker and a convenience to electricians as well. It would probably be advisable, however, in forming the practical unit to make the henry one one-hundredth of an earth-quadrant, so as to avoid the too frequent use of small decimals. There being little agreement as to the present name of the unit in question a change will be comparatively easy.

A Miniature Plant.

WE publish this week a report from England of a complete test of a small house-lighting plant such as is not infrequently used on the other side of the water. It is instructive as showing what can be done toward domestic electric lighting without special pains or skilled attendants, and upon a very small scale. The plant described is practically a one horse-power affair operated by an Otto gas engine of one-half horse-power nominal. As is usual in such cases storage batteries are employed in connection with the dynamo, which is only operated when required to recharge the cells. The result shown is quite satisfactory. Less than 10 cents per kilowatt hour is certainly anything but a high cost of production, even when we take into account the fact that such estimate does not include interest, depreciation or extra wages on account of attendance, the plant being cared for by the servants already at hand. It is strange that more is not done in this country toward domestic electric lighting of this character. There are very many country places, the owners of which would be glad to have the privilege of using electric light, even at a cost greater than that of gas, but have been deterred by apprehensions of the difficulties to be encountered. These are really considerably overrated, for experience seems to have shown that electric lighting by such means is neither inconvenient nor expensive.

A Business Opportunity.

THE proposed continuance of an oppressive tax on the importation of copper, mica, and other materials has been spoken of by us as a positive menace to the ascendancy of the United States in electrical manufacturing. We have not concealed our belief that the McKinley bill is inimical to the interests of electricians, and it is therefore with satisfaction that we welcome a proposition, emanating from the Secretary of State, which seems calculated to enlarge the market for the manufactures of this country. That a manufacturer should strive to enlarge his market seems to us a truism; and that our electric companies would greatly profit by any arrangement that would open to them the Latin-American markets is surely equally true. Especially desirable would be an opportunity to exploit these markets on better terms than their German and English rivals can obtain; and if, in addition, cheap freight rates can be got by giving ships plying southward the much desired "return cargoes," then it is reasonable to suppose that the electric development of South America would soon become a field of great profit to our manufacturers. All these ends seem to be met in the suggestion referred to, which is that the present sugar duties be left as they are, to be used as a basis for reciprocity negotiations with other American republics. It is proposed to say, for example, to Brazil or Venezuela or the Argentine, "If you will let our dynamos enter your ports free of duty (the tax on English dynamos being left as it is) we will in return open our ports to your sugar." The advantage of such a bargain is self-evident. Our goods obtain a market practically closed to European products, because of the high tariffs on the latter as against the free admission of the former; ships taking our goods to the south come back loaded instead of empty, meaning cheaper freights for us to pay; and even from the protectionist point of view we risk nothing in our home market. This is not, then, a question that in any way enters into the political discussion of free trade and protection; it is simply a shrewd, business-like bargain, which there is reason to believe may be driven with our southern neighbors, to the enormous profit of our own producers. We trust that the plans of the distinguished Secretary of State will be adopted by the Senate when the McKinley bill comes before it. If a reduction of taxation is necessary—and it certainly is much to be desired—let the duty be taken off copper and mica, raw materials of important industries, rather than off sugar, the raw material of a huge monopoly.

Railway Lighting.

THE paper read by Mr. M. B. Leonard at the meeting of the Association of Railway Telegraph Superintendents is worthy of more than casual notice. It deals with the use of electric lighting in the service of railways, and treats a wide subject in a very compact and complete manner. The electric light first found its way into favor with railway officials from its great usefulness as a method of illuminating stations and yards where in many cases there is much night service, and where the need for something more powerful than lamps or gas had long been felt. But it is not so much with this old application as with the newer and more revolutionary ones that Mr. Leonard concerned himself. Particularly favorable was his notice of the electric locomotive headlight, which is a comparative novelty to most of us in spite of the fact that its use had been long ago suggested, and experiments had been tried in various places and with varying degrees of success. From the present account it appears that the difficulties that have heretofore hindered the introduction of the arc lamp for headlights have largely disappeared owing to improvements in apparatus, and that the trials made have been highly satisfactory. For such a use it is necessary to have a lamp powerful enough to illuminate the track for a long distance ahead of the train, and the recent test shows that any serious obstruction on the track, unless in the case of a very thick fog, would become visible far enough ahead to stop a train running at the rate of 45 miles an hour. Such is not the case with the ordinary oil headlight, and as higher speeds come into general practice the need of some powerful search light instead of the present lamp will become more and more marked. Another use unfamiliar to most of us is that of the electric light as a signal on switch stands, first extensively introduced by the Southern Pacific Railway Company. For this purpose incandescent lamps to the number of 134 were put in at Oakland, Cal., and the result of several years' experience has been to show that the new system is not only simpler and more trustworthy than the oil lamps that have been previously used, but actually less expensive by an amount not inconsiderable. Perhaps the most interesting part, however, of Mr. Leonard's paper is that which deals with the subject of lighting passenger trains. He reviews briefly what has been done in this country and then calls especial attention to the even greater success that has been attained in England. The practice there is very favorably inclined toward a system of driving the lighting dynamo from a car axle instead of from a separate engine. In such a case special precautions are necessary in order to drive the dynamo at the proper speed for charging the accumulators used in connection with it. A frequent method is to throw the dynamo into action by means of a centrifugal governor when a certain speed corresponding to that desired of the dynamo is reached. The arrangements are somewhat complicated, but the results reported are very encouraging, and the amount of attention required is considerably less than that rendered necessary by the miniature central stations used in our own trains. The objection to such a method of getting power applies principally to American railways, where it was found a few years since that the numerous curves, around which the wheels have a tendency to slide, disarranged the driving gear, and varied the speed in a way that produced no small amount of trouble. Whether the difficulties then met may be overcome in more recent apparatus remains for experiment to determine; but the plan of driving a dynamo from the car axle certainly possesses marked advantages in the matter of economy, for the reason that the small engines used in American train lighting have proved to be exceedingly uneconomical, whereas driving from an axle is almost equivalent to getting the power direct from the locomotive.

ELECTRICAL WORLD PORTRAITS.—XV.

EDWARD LEAMINGTON NICHOLS.

Edward Leamington Nichols, whom we add this week to the series of ELECTRICAL WORLD portraits, is the son of the late Edward W. Nichols, of New York City, and was born thirty-six years ago. His father was a well-known landscape painter, and it was, therefore, owing mainly to his natural bent that the son turned to science. He was prepared for college at the Peekskill Military Academy, and entered Cornell University in 1871, at the age of seventeen. Here he studied under Prof. W. A. Anthony, now President of the American Institute of Electrical Engineers, and then at the opening of his long and successful career in the chair which his pupil, Nichols, was to be called upon to fill fifteen years later.

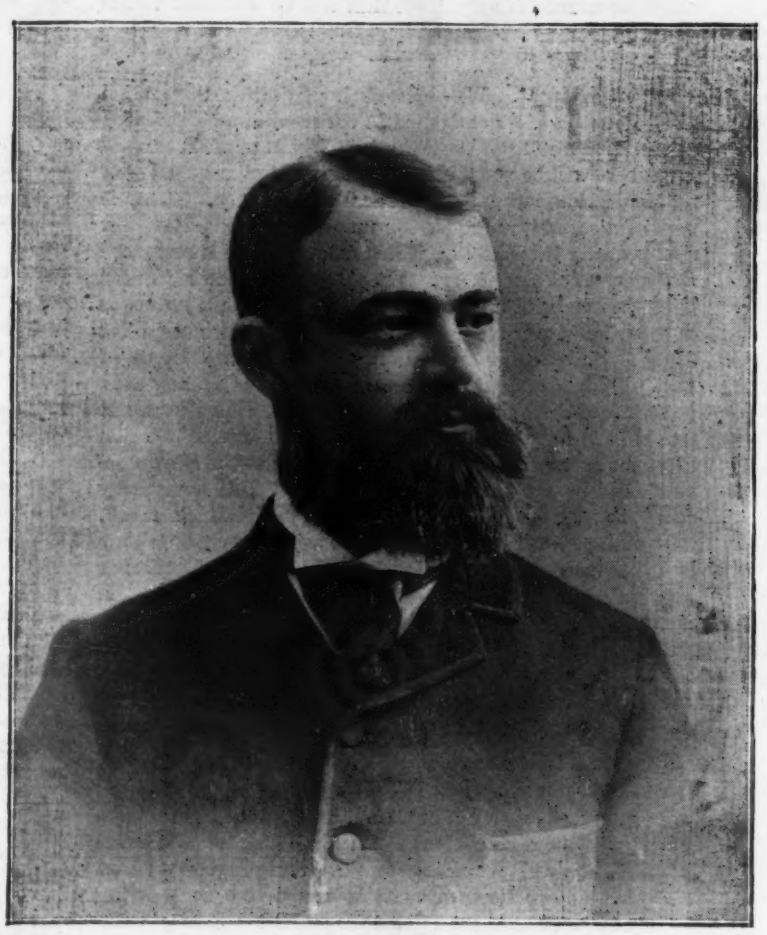
After graduating from Cornell, in 1875, Mr. Nichols went to Germany to continue his studies in physics. He first spent a year at Leipzig under the Wiedemanns, father and son, and then went to Berlin, at that time the Mecca of students of physics, owing to the presence there of both Kirchhoff and Helmholtz, two of the greatest of physicists. Two years were passed in the laboratory of Professor von Helmholtz, and then part of another year under Professor Listing, of Göttingen. Here Mr. Nichols received the degree of Doctor of Philosophy, and immediately afterward he was appointed fellow in physics at Johns Hopkins University, and returned to America to work in the laboratory of Professor Rowland.

In 1880 Professor Nichols joined the Edison forces at Menlo Park, being engaged chiefly upon the problems connected with the testing of incandescent lamps until he received the appointment of professor of physics and chemistry in Central University, Richmond, Ky. From there he went to the University of Kansas, at Lawrence, where he developed plans for establishing a course of electrical engineering. Similar steps had been taken at Cornell, and when, in 1887, Prof. Anthony resigned his chair to enter the field of commercial electricity, Prof. Nichols was promptly sought by the authorities of his *alma mater* to fill the vacancy.

Prof. Nichols is the author of about 40 papers and memoirs, chiefly upon experimental physics, which have appeared in the *Annalen der Physik und Chimie*, the *Philosophical Magazine*, THE ELECTRICAL WORLD, the *American Journal of Science*, *Nature*, and the *Transactions* of the several scientific societies.

There are not many men connected with the electrical progress witnessed during the past ten years in this country who have been fortunate enough to unite a thorough theoretical training with such valuable practical experience in commercial laboratories as Professor Nichols has had; and a survey of the different electrical departments that have sprung up in the universities of America will show few that have had the good fortune to secure the services of two such good electrical instructors as Messrs. Anthony and Nichols. Cornell has found a worthy successor to a worthy pioneer.

It is interesting to note that much of Mr. Nichols earlier work was on general physical subjects, optics being a matter to which he devoted considerable attention; and his thorough mastery of this branch of higher mathematics perhaps assisted in developing a bent of mind capable of turning with ease and certainty to the more practical fields of applied electricity.



PROF. EDWARD L. NICHOLS.

American Names for Electrical Units.

At the regular monthly meeting of the American Institute of Electrical Engineers, held June 17, 1890, the following resolutions, recommended by the council, were introduced by Mr. Francis B. Crocker, with the request that they be taken up for action at the next meeting of the Institute in September:

Whereas, It has been the custom in the nomenclature of electrical units to perpetuate the names of men who have contributed most to electrical science, and

Whereas, In the names thus far adopted the eminent services of Americans have not been recognized; therefore,

Resolved, That in the opinion of the American Institute of Electrical Engineers, a just distribution of the honors thus bestowed necessitates a recognition of the splendid contributions to electrical science of one or both of America's great electricians—Benjamin Franklin and Joseph Henry; and,

Resolved, That this Institute will gladly co-operate with other bodies in this country and abroad to secure the general adoption of these names for electrical units; and,

Resolved, That the name of Henry should be given to the practical unit of self-induction, since he was the discoverer and greatest investigator of this phenomenon, and because this unit at the present time is called a quadrant, which is merely a numerical value, and not a suitable name.

Resolved, That this Institute recommend to electrical societies and electrical engineers the general use of the name Henry for the unit of induction as being the quickest and surest way to secure its final adoption.

It is unfortunate that the name of Henry for the unit of induction was not adopted at the Paris Electrical Congress of 1889. If the attention of the Congress had been forcibly called to the fact that Henry discovered self-induction and that his work on both self and mutual induction was of the greatest importance, his name would probably have been adopted then. Henry's discovery of self-induction, which is, of course, the fact that gives the strongest claim, was made in 1832 and published the same year in *Silliman's Journal*. In that paper he described experiments showing that the spark obtained by breaking a circuit composed of battery and a long wire is greater than with a short wire, and that the spark is further increased by coiling the wire. He then clearly states that the phenomenon is due to the *action of the current on its lf*, all of which is perfectly correct, and would be a good statement of the facts even at the present time.

Thermo-Chemistry in Relation to Electromotive Force.*

BY PROF. J. E. SIEBEL.

The quantitative relations between the chemical changes taking place in a galvanic battery and the quantity of electric power generated by such battery, are well understood. The amount of heat generated in the whole circuit is equivalent to the total electric power or voltampères (electromotive force times current strength) generated by the battery, and also equivalent to the amount of heat which would be produced by the chemical changes going on in a battery, had the same not been converted into electric energy. Attempts have also been made to establish relations between the electromotive force and the chemical changes going on in a battery, and, according to Sir Wm. Thomson, the amount of heat corresponding to the chemical changes going on in a battery while one molecule of zinc is dissolved is proportional to the electromotive force of such battery. This indeed happens to come out correct in the case of some constant batteries having a depolarizer, but it can readily be seen that it is not generally applicable. Take, for instance, the case of several elements each made up of zinc as the electro-positive metal, acidulated water and another more electro-negative metal, say iron, copper, silver, etc. In the case of each of the different elements so formed, the electromotive force is a widely different quantity, while the heat equivalent to the chemical changes in the battery while one molecule of zinc is being dissolved, is the same in all cases, since no chemical changes take place at the negative electrodes.

Considerations of this kind and the conviction (based upon the result of certain deliberations the drift of which it is not desirable to enlarge upon at present) that definite relations of some kind must exist between the chemical changes in, and the electromotive force of, a battery have lead me to the elaboration of a formula, which I think covers the subject quite satisfactorily. At present I will only consider its application to batteries consisting of two metals and diluted sulphuric acid. The electromotive force of such elements is according to the inferences drawn by me nearly proportional to the difference of the heat which a molecule of each one of the two metals could evolve by being acted on by diluted sulphuric acid independent of the battery under favorable conditions. In order to establish the correctness of this assertion I submit the following tables which also will more readily show the import of the rule referred to. The first column in this table gives the names of the various metals, the second column, their electromotive force in juxtaposition to dilute sulphuric acid expressed in volts. In these figures the electromotive force of zinc may be considered as a number somewhat arbitrarily chosen, yet with reference to it the other figures represent the electromotive force as established by Hockin and Taylor, J. Tel. Eng., 1879. The third column shows the relative amount of heat in calories generated by one molecule of the different metals in being dissolved by diluted sulphuric acid. It is readily seen that the heat evolved increases with the electromotive force evolved in volts multiplied by 1,000 for each calorie produced by the combination per molecule of the respective metal with sulphuric acid and the elements of water.

Potassium.	3.560	196,000	0.0180
Sodium.	3.460	187,000	0.0185
Zinc	1.580	106,000	0.0140
Cadmium.	1.220	89,500	0.0137
Tin.	1.050	Not determined.	
Lead.	1.000	73,800	0.0143
Iron.	1.130	87,200	0 0120
Copper.	0.580	56,000	0.0104
Silver.	0 300	20,400	0.0147
Gold.	0.280	Not determined.	
Mercury.	0 260	" "	
Platinum.	0.150	" "	
Carbon.	—0.276	—18,500	0.0148

Although the figures in the fourth column are by no means exactly alike as they should be, in accordance with the theory pronounced, yet they show plainly enough that a direct quantitative relation exists between the electromotive force and the heat of combination; moreover, it should be considered that it would have been a very easy matter to make them correspond exactly to my theory by substituting the value of some electromotive forces by such as have been obtained by some other observers. Furthermore, it is also to be presumed that other atomic properties do in some measure affect the above relation; indeed the fluctuations in column four in some measure appear to follow the fluctuations in the atomic volume of the different metals.

So far as the limited amount of observations in regard to electromotive forces and thermo-chemical phenomena have enabled me to go, I find the above relations maintained in batteries composed of other materials than the ones selected above; moreover, the applicability of the law of Sir Wm. Thomson above quoted in regard to certain batteries would seem to be a special case falling under the above generalization.

As stated, the values of electromotive forces in the second column of the above table are based on the determinations made by Hockin and Taylor. They were, however, reduced to zinc not amalgamated. In the case of sodium and potassium the electromotive force had to be corrected also, as a solution of sulphate of zinc was used instead of diluted sulphuric acid in their case. Carbon not being mentioned by them, this item was supplied from the observations of Branly (Ann. sc. de l'ecole normale, 2 pag. 228, 1873). The thermo-chemical data in the third column were taken from a table in "A. Naumann's Thermochemie," 1882, page 481. The item relating to carbon, representing the heat evolved by carbon in combining with hydrogen, was taken from the same source, page 413, and it is placed in the negative, representing as it does, not an actual change, but a demonstration of an affinity or tendency acting in opposite direction to that of zinc and other more electro-positive metals, the tendency of which is to form oxygen compounds under the circumstances in consideration. It will also be noticed that the relative electromotive forces will not be changed by adding or substracting the same number in case of each of the figures in the second column, and that by changing these figures in this manner, the relations referred to may possibly be brought out more correctly.

Connected with the above subject, at least as regards the theoretical consideration involved in both, is a method of producing refrigeration by means of electricity planned some time ago. It contemplates the creation of cold in such a manner that the heat abstracted from the medium to be refrigerated is made a source of power, instead of being wasted as is done in the refrigerating machines of the present. This it is proposed to bring about by the decomposition of water under high pressure by an electric current produced by a dynamo or otherwise.

The gases so produced, viz.: hydrogen and oxygen either singly or mixed, are used to propel engines by reason of the energy they possess being under high pressure.

After having done work in this manner and having had their temperature reduced correspondingly, the gases can be used for refrigerating purposes by being carried through the rooms to be cooled. After this, the gases, by virtue of their chemical affinity toward each other, still possess sufficient energy to be utilized in the form of electricity or mechanical force for the decomposition of the water. In this manner the power of the engine in which the compressed gases expand and the refrigeration would be clearly gained. This, of course, is speaking theoretically; practically there are of course losses of power the extent of which I have not yet undertaken to determine. Theoretically speaking, however, I have been unable to find any principal objection to the system proposed, but am very much

*Read before the Chicago Electric Club, June 27, 1890.

pleased to have had an opportunity to lay the subject before a body of men, some of whom doubtless would be able to point out such difficulties if they really exist.

To caution those who are apt to see an attempt at perpetual motion in the above method, I will distinctly state that the above device is nothing of the kind. It is a system calculated to effect the conversion of low differences of heat potential into mechanical power, but it is not an attempt to create power from nothing, which is the essential of perpetual motion as it is popularly understood. For, although theoretically speaking, such an arrangement would keep in motion forever under ordinary circumstances, after being once set in motion on the above plan, yet it would stop at once if the difference between the temperature of the expanded gases and that of the rooms or tanks to be refrigerated should fall below a certain limit, as might indeed happen in cold weather or in a cold climate.

The Minneapolis and St. Paul Street Railway System.

A few months since, when the news was flashed across the continent that a great street railway corporation, after contracting for the building of a system of cable railways in Minneapolis and St. Paul, part of the required material having been delivered, had turned about and adopted an electrical system simply on the score of economy of maintenance and operation, there were but few street railway men who did not realize what an extraordinary undertaking this was. To-day over twenty miles of track are laid with a new 78-pound rail, the roadbed is cleaned up, and unless serious interruption occurs the motor cars will be running over fully 130 miles of track before November first. Nearly 800 men are employed on the Minneapolis end alone. The overhead trolley wire is being suspended from the curved bracket arms of handsome Walworth hollow iron poles that are placed in the center space between the two sets of tracks. This feature does away entirely with the use of supporting wires spanning the roadway. The heavy feeders are drawn into one-inch tubes, previously placed in square frame boxes and an insulating compound poured over and around the contents till the tubes are joined in one solid mass. This box is placed in the center space between the rails and the feeder wires brought to the surface through junction tubes and carried up within the hollow iron poles. Over 750,000 feet of tubing will be furnished by the Interior Conduit and Insulation Company for this installation, one conduit box on the main line holding 56 tubes. Too much credit cannot be given to Colonel Lowry and his able assistant, Mr. Clift Wise, for thus doing away with both the overhead feeders and the span wires.

The Sprague motors of 15 h. p. each are already at hand and are being placed in position on the cars, while the 200 h. p. Edison generators are now en route. Both the Minneapolis and the St. Paul power houses are nearing completion, the foundations for the three 1,000 h. p. Allis-Corliss engines, and for the 270 h. p. Babcock & Wilcox boilers are completed, and one of the engines will be set up this week. As the distance from the river is but a short one, the water required in the St. Paul power house will be drawn through an iron pipe. But in Minneapolis a tunnel 1,600 feet long and six feet in height is being excavated from the power house to the water, at which point it is expected to be ten feet below the river bed, and through this tunnel, which is located 50 feet below the street surface, a constant and ample supply of water can be secured at a moderate expense.

When the entire line is in operation it is expected that a rate of speed can be easily maintained between the outskirts of the two cities that will make this the most popular passenger route, an expectation that is already being anticipated as shown by the great increase in dwellings along the line and the steady rise in value of real estate. In fact, the property owners look upon the completion of the line as a mammoth enterprise deserving the highest commendation. In this connection it may be well to add that it is rumored that Mr. Villard is behind a deal to consolidate the St. Paul Gas Light Company, the St. Paul Edison Company and possibly the Minneapolis Edison Company, and that he proposes to erect a station of great capacity close to the river in St. Paul and supply arc and incandescent lights and current for small motors, and also to furnish all the current required in operating the St. Paul electric railway system. A suitable field for the gigantic energy of Mr. Villard seems to be presented in this case, as in the other enterprise concerning which rumor has been rife.

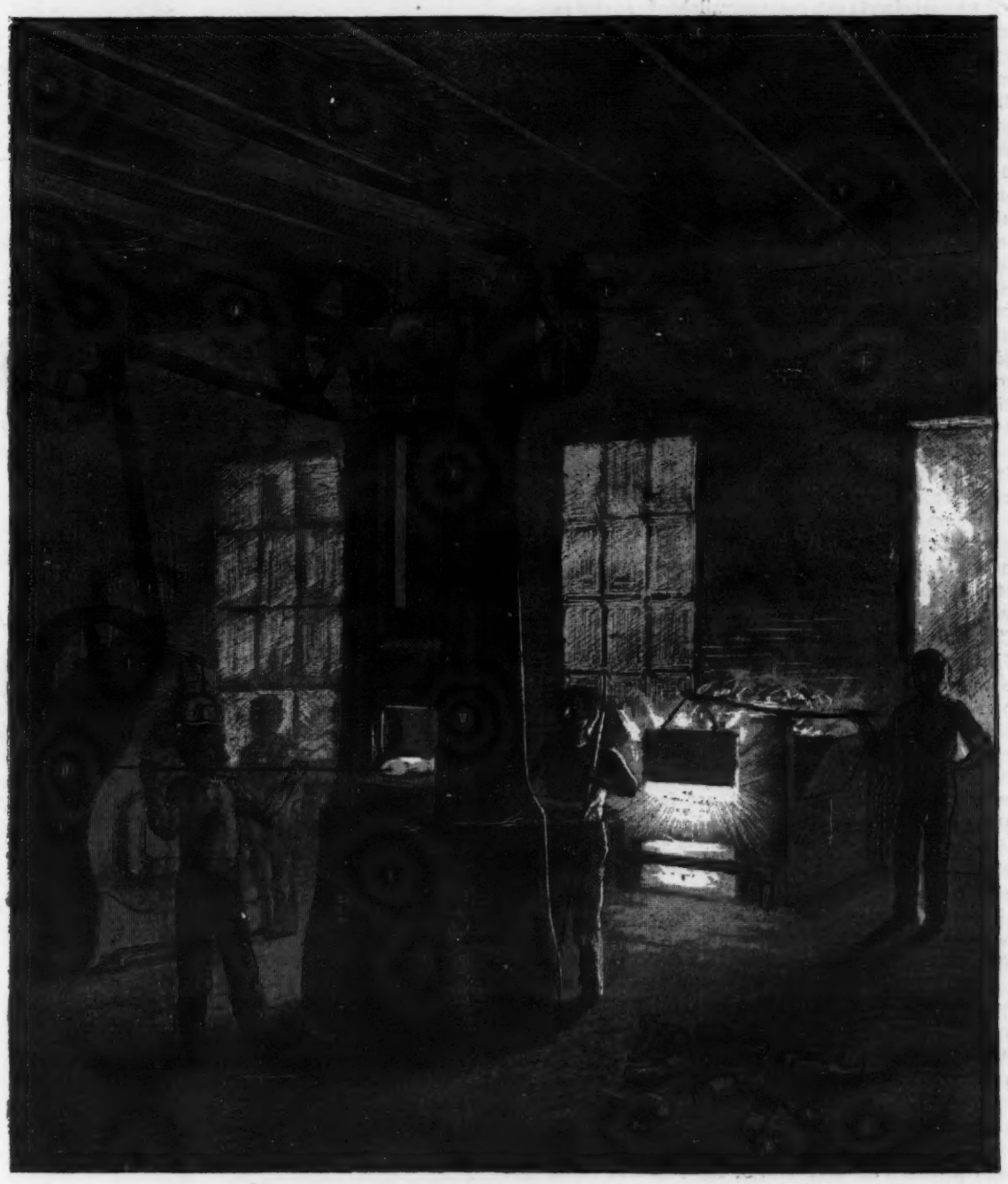
Forging Field Magnets.

With the advent of the small motor, designers of dynamo-electric machinery encountered a series of difficulties especially formidable. To build a large machine, so as to secure high efficiency and good mechanical properties, is not a particularly difficult matter; but to embody the same excellence in a little motor of $\frac{1}{16}$ to $\frac{1}{2}$ h. p. involves an immense amount of careful computation and fine mechanical adjustments. Especially is this true with motors designed to run, as most of these small machines are, on incandescent circuits of standard voltage. A 110-volt constant potential motor of small size must necessarily have very many turns of wire upon its armature and a very powerful magnetic field, unless it is to run at a preposterously high speed.

It was a great step forward when the cast field magnets generally used were abandoned for these smaller sizes and the drop forge field was introduced. We show herewith something of the process of making forged field magnets, as seen in the shops of J. H. Williams & Co. in Brooklyn. The main forge stands in the foreground, and is adjusted to work not only the tiny bits of metal for the smallest motors, but the massive magnet cores and pole pieces intended for large sizes. The process is a comparatively simple one, not essentially different from other drop forging, except in the size of the work done. For the largest pieces only a comparatively few blows from the heavy drop are required, although the process is not a particularly rapid one.

The ingot is heated to dazzling whiteness, thrust under the drop, and eight or ten blows from a 2,100-pound hammer force it into the dies and do the major part of the work. It is then taken out, placed in a furnace, reheated and returned to the forge, where two or three more blows complete the forming. It is then again heated and taken to the cutting press shown on the left of our cut, where the projecting edges left by the first forging are trimmed off and the piece is practically completed. The immense advantage of this drop forging process for field magnets can be understood when we realize that the use of this sort of iron decreases the magnetic resistance of a finished machine by a very large amount and renders it possible to secure a far stronger field with the same expenditure of energy and to build a motor which shall at the same time be efficient and of comparatively slow speed. Williams & Co. now forge not only the fields for the Crocker-Wheeler motor, which were being made at the time of our tour of inspection, but also other forms for the C. & C. Motor Co., the Cleveland Motor Co., and the minute motor used in the Edison phonograph.

Of course, the process of drop forging comes into play in a large number of different ways to facilitate the making of electrical machinery. Many commutator bars, for instance, are forged in the shops that we have just described, and other necessary parts of electrical apparatus; but there are few places where the advantages of using forged instead of cast material are so prominent and so numerous as in the case of these motor fields, and it is probable that the amount of such work will rapidly increase, as the excellent machines resulting from the free use of wrought iron in the magnetic circuit have already forced their way into deserved prominence.



DROP FORGING ELECTRIC MOTOR MAGNETS.

Where Electrical Energy is Utilized.

BY H. FRANKLIN WATTS.

It is interesting to observe how the ideas of men upon many scientific matters have gradually changed in the last few years. Upon no subject has this change been more noticeable or more radical than upon electricity and magnetism. The point of view from which the investigator now surveys the broad fields of electrical science in his search after fundamental facts and true theories is wholly different from that from which only a few years ago nearly every scientist was content to look upon the subject of electricity, then regarded as a comparatively unimportant branch of physical science. These changes are in perfect keeping with the march of progress, and indicate the natural and rapid growth of a great idea and the logical working of scientific minds based upon thorough technical education; and if the present rate of march continues we shall in the near future be able to determine, to use an expression of Agassiz, "the exact age of this world.

In the same manner that the dynamo has aided in the discovery and devolopment of the fundamental principles of electricity to a greater extent than any electrical apparatus before constructed, so the modern transformer gives us a better opportunity to study the underlying principles of magnetism and of electro-magnetic induction than any other piece of apparatus in existence. In the beautiful experiments of Prof. Elihu Thomson, recently performed and described before the American Institute of Electrical Engineers* and since repeated and supplemented before the Society of Arts in London, by Dr. J. A. Fleming,† the alternating current transformer, in a more or less modified form, was used in almost every instance. Prof. Thomson has utilized in these studies of magnetism and the effects of electro-magnetic induction, in a great variety of very ingenious ways, the simple and fundamental principle of the ordinary transformer.

The popular idea of magnetism, not so very long ago, was represented pictorially in the books of the day by a straight or a horse-shoe magnet with iron filings clustered around the poles. Had the magnet not been able to attract the iron filings it would not have been considered a magnet. The modern idea of magnetism, as developed by experience with the transformer, would be represented by a closed iron ring overwound by coils throughout and devoid of any

*See THE ELECTRICAL WORLD, April 19, 1890, p. 274.

†See THE ELECTRICAL WORLD, June 14, 1890, p. 406 and June 21, 1890, p. 422.

external magnetism whatever. But it is true that popular notions have also changed somewhat with regard to the electric current. That the energy of an electric current exists largely in the space surrounding the wire is quite a recent conception, and the opinion is still prevalent that the energy *in* the wire itself is much greater than that existing in the form of "magnetic whirls" surrounding the wire. The modern idea seems more difficult to grasp than the older one, but this is doubtless due to the fact that many other notions of electric current phenomena have become crystallized about the fundamental idea of current flow within a wire.

It is now the intention of the writer to put forth an argument which, if it shows anything at all, would appear to show that the electric energy in the form of magnetic whirls surrounding a wire through which a current is passing *may constitute the entire energy of the circuit*, and that in certain apparatus these magnetic whirls are *the only portion of the energy of the circuit which can be utilized* for lighting purposes, while in other apparatus the energy in the wire itself may constitute the total energy of the circuit, or this may be the only part of the energy which can be used for lighting purposes, the energy of the magnetic whirls being in this case unavailable.* In still another form of apparatus both the magnetic whirls and the energy in the wire itself are utilized in certain fixed proportions.

If we take an ordinary electro-magnet and pass a current through the coils, what is it that magnetizes the iron core? Is it that part of the energy which is confined to the wire? Is it not more than probable that it is the energy of the current which exists in the form of magnetic whirls which surround the wire? If this is true it must also follow that the magnetic whirls or lines are the only portion of the energy which can affect the iron core at all, since they are the only part of the electric energy which is outside of the wire, and hence in a position to influence the iron core. In an electro-magnet, then, it is the magnetic lines surrounding the wire coils that magnetize the iron, and not the energy *in* the wire at all.

Next take an incandescent filament or an arc existing between two carbons. What produces the heat and consequent light? Is it the energy *in* the filament, carbon point, or wire, or is it the magnetic lines *surrounding* the wire? It must be the energy in the conductor itself, since we have no evidence that mere magnetic whirls or lines not reversed can produce such effects. In an arc or an incandescent filament, then, it is the energy in the conductor that gives the light, the magnetic lines or whirls having no effect.

Carrying this argument one step further, and taking an ordinary converter, we may ask, What is it that influences the iron core? Is it the energy existing in or confined to the primary coils, or is it the energy in the form of magnetic lines or whirls surrounding the primary coils? Have we any right at all to think that the electric energy in the primary coils has any influence whatever upon the iron core or the secondary coils? Is it not far more probable that it is the magnetic lines surrounding the primary coil which have the sole effect? Inasmuch as the total energy in the primary circuit is, through the converter, made available by induction entirely, it is evident that the magnetic whirls surrounding the primary coils of the different converters may and do constitute the total electric energy of the dynamo or primary circuit, and the electric energy existing in and confined to the primary coils cannot be utilized at all. In the secondary circuit of the converters the opposite action takes place.

Briefly stated the points to which attention is directed are these:

(1.) In an arc circuit the magnetic whirls surrounding the conductor affect the regulation of the lamp mechanism, or carbons, while the energy in and confined to the conductor produces the arc; both of these effects being utilized in varying proportions.

(2.) In a direct current incandescent system, only the energy in and confined to the conductor can be utilized. This, however, may constitute the total energy of the circuit.

(3.) In an induction or converter system (operated entirely through converters), only the magnetic whirls surrounding the conductor can be utilized. These whirls may also constitute the entire energy in the circuit. The secondary circuit is similar to the direct current system.

(4). In dynamo-machines or motors only the magnetic whirls surrounding the conductors can be utilized. This may represent the total electric or mechanical energy absorbed, or delivered to the circuit.

(5). In all electro-magnetic or inductive apparatus, the magnetic whirls surrounding the conductor are all that can be utilized.

Finally, the magnetic whirls can alone magnetize, while the energy existing in the conductor itself can alone produce heating effects. Both together, or each in turn, may equal the total energy applied to the circuit.

I might also add another, namely, that both the magnetic whirls and the energy in the wire mutually assist in their own maintenance and in the general support of the energy of the circuit.

*The energy existing in the wire itself is here spoken of as being separate and distinct from that portion of the energy in the form of magnetic whirls surrounding the wire.

Lighting Allegheny City.

Rogues have begun to tremble in the city of Allegheny since the first of July, for the municipality is now brilliantly lighted by electricity. Thieves and evil-doers in general have no particular love for well-illuminated streets. The last four of the many towers which form a portion of the new electric lighting system for Allegheny have just been erected, and with a few finishing touches on the interior of the power house on Braddock street all things will be completed.

The building is built of brick in a tasteful and substantial way, with few trimmings. On the first floor is situated the dynamo and engine room, containing seven 100 h. p. compound, one 50 and four 15 h. p. automatic engines, all of the Westinghouse manufacture; nine 50-light alternate current arc machines of the new Westinghouse system, and three 1,000-light alternate current incandescent Westinghouse machines. The switchboard is of a late design, with a few London features. It includes six incandescent circuits and nine arcs, with all the latest instruments. The room is finished in yellow pine. When completed, the walls will be covered with adamant plaster and the floors will be of asphalt. A balcony extends entirely around the room, making the steam lines of easy access.

In the boiler room are six Erie boilers, with a Roney stoker for each. Three stacks 4 × 60 feet are used for draft exclusively, as the stokers consume all smoke coming from the furnaces. The boilers are supplied with two Gordon pumps and two brass water tube heaters. A switch has been laid from the Fort Wayne tracks, a short distance away, into the coal sheds. Elevated tracks will connect the coal sheds with the boiler room, and coal will be dropped into the furnace hoppers from small cars. The boiler room floor will be of concrete.

In the second floor will be a repair shop and testing room, as well as the office of Superintendent David Hunter. From the centre of the building is reared a pretty tower, and when one reaches the top of this he is rewarded by a fine view. About thirty-five of the towers scattered here and there throughout the city are in plain sight of this tower. Into the tower are run the wires of the different circuits.

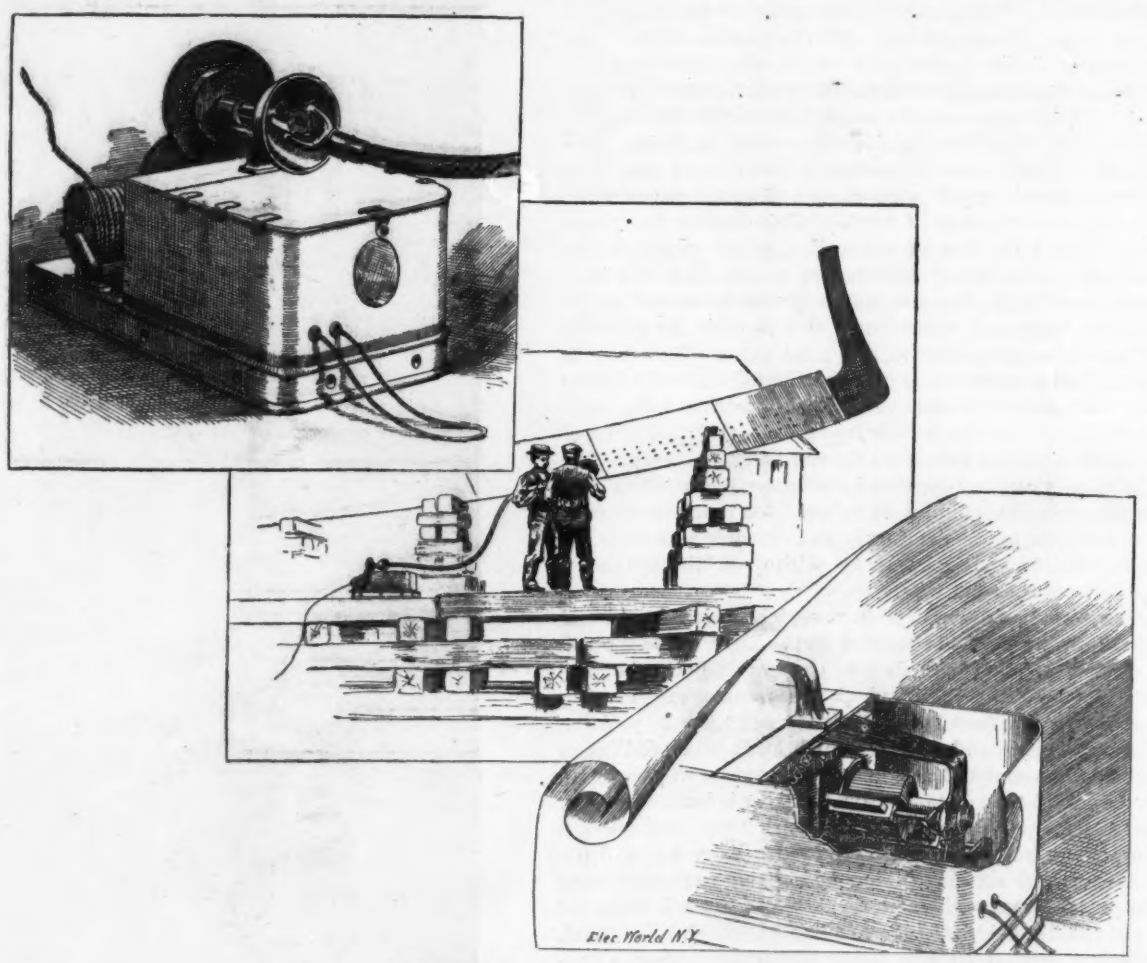
Reese Tannehill, the contractor for the building, has completed his part of the work, and Superintendent Hunter is much pleased with it. Maurice Coster, of the North American Construction Company, and James Sweeney, of the same company, have had charge of the inside and outside construction work. The Westinghouse Electric Company has spared no pains with this plant, and has more than made good its contract by furnishing extra materials and about 1,500 incandescent lamps not called for in the agreement. The Electric Company will run the plant six months without cost to the city. The cost of the entire system was $141,000, of which sum about $32,000 went into the building. The total number of towers is 52. There are also 25 mast-arms, with 100 intersecting lights, scattered throughout the city. The City Hall, engine houses and other public buildings are liberally supplied with incandescent lights. On the whole, it would appear beyond question that the citizens of Allegheny have just cause to feel pride in their electric lighting system, and the expectation is that in all particulars it will prove a thing of perfection. Since the plant began running, some of the people of the town are wondering if from the city's plant light might not be furnished to residents for private use. It is thought that in such a way illumination might be secured at moderate cost. Perhaps a measure may be introduced asking for the enlargement of the plant to the end that citizens so desiring may be supplied with light from it.

Electric Drills at the Brooklyn Navy Yard.

A visitor to the Brooklyn Navy Yard is impressed in more than one way with the ever-increasing importance of the rôle that electricity plays in our naval service, and in no manner is this exhibited more strikingly than by the motor drill shown in our cut. In the construction of a modern iron ship an enormous number of holes must be drilled through plates varying in thickness from half an inch to 1½ inches, and sometimes thicker, often in very inconvenient positions and under such conditions that the work must be done at a decided disadvantage. Such, for example, is the case on board the monitor "Miantonomah" now being rapidly completed, where a vast amount of drilling has to be done around the turrets intended for the great 10-inch rifles, and perhaps from the interior of the turret and in a position where the use of a power drill for the purpose would seem well nigh impossible.

The electric drill, however, comes into play with immense effect. The machine shown is one of a number employed in several services about the Navy Yard, and is quite a small affair, easily carried around by a couple of men. The box containing it is about 18 inches long over all, and bears beside the motor only a reel of wire for connecting with the source of power and the flexible shaft that operates the drill. Once clamped in position, the motor, which in the case shown runs 2,800 turns per minute, but is geared down to comparatively low speed, does its work with great efficiency, and an inch hole can be drilled through half-inch iron in less than 30 seconds, while a couple of men handling the machine can accomplish an amount of work that appears prodigious to one who is used to the clumsy hand methods of drilling or the steam power drills that require elaborate setting up and are exceedingly inconvenient to move around. The motors, as well as the other machinery of the drill, are made by the Electro Dynamic Co., of Philadelphia, and range in size, approximately, from ¼ h. p. to 1 h. p., in the various machines made. They are, as will be seen from the lower one of our three cuts, of the double magnetic circuit type, shunt wound for 110-volt circuit. The reduction of speed by gearing is necessarily great, but is accomplished with comparatively little noise and wear, and the flexible shaft, six or eight feet in length, which connects the motor with the drill proper, enables the drill to be used in the most contracted positions.

Our central cut shows the application of the machine under more favorable circumstances than seen elsewhere in the yard, for here it was working, with plenty of free space, on the keel of cruiser No. 7, now under construction. It is reported as giving great satisfaction, and the most casual inspection of the work being done with it cannot fail to convince the looker-on that the electric motor has made itself thoroughly at home in the work of naval construction.



DRILL OPERATED BY ELECTRIC MOTOR.

An Electric Light Plant Operated by Gas Engines.

All the electric light plants in the country, with perhaps here and there an exception, are operated by three distinct types of prime movers, viz.: the steam engine, the water wheel and the gas engine. Of these three sources of power the gas engine furnishes, perhaps, the most interesting study of both theoretical and practical problems involved in its application to this particular class of work. The number of plants now operated in this way is much larger than is generally believed to be the case, and is rapidly increasing. Many plants of comparatively large size are now installed here and there throughout the country in connection with gas lighting plants, from which gas is furnished to the engines for driving the electric light machinery.

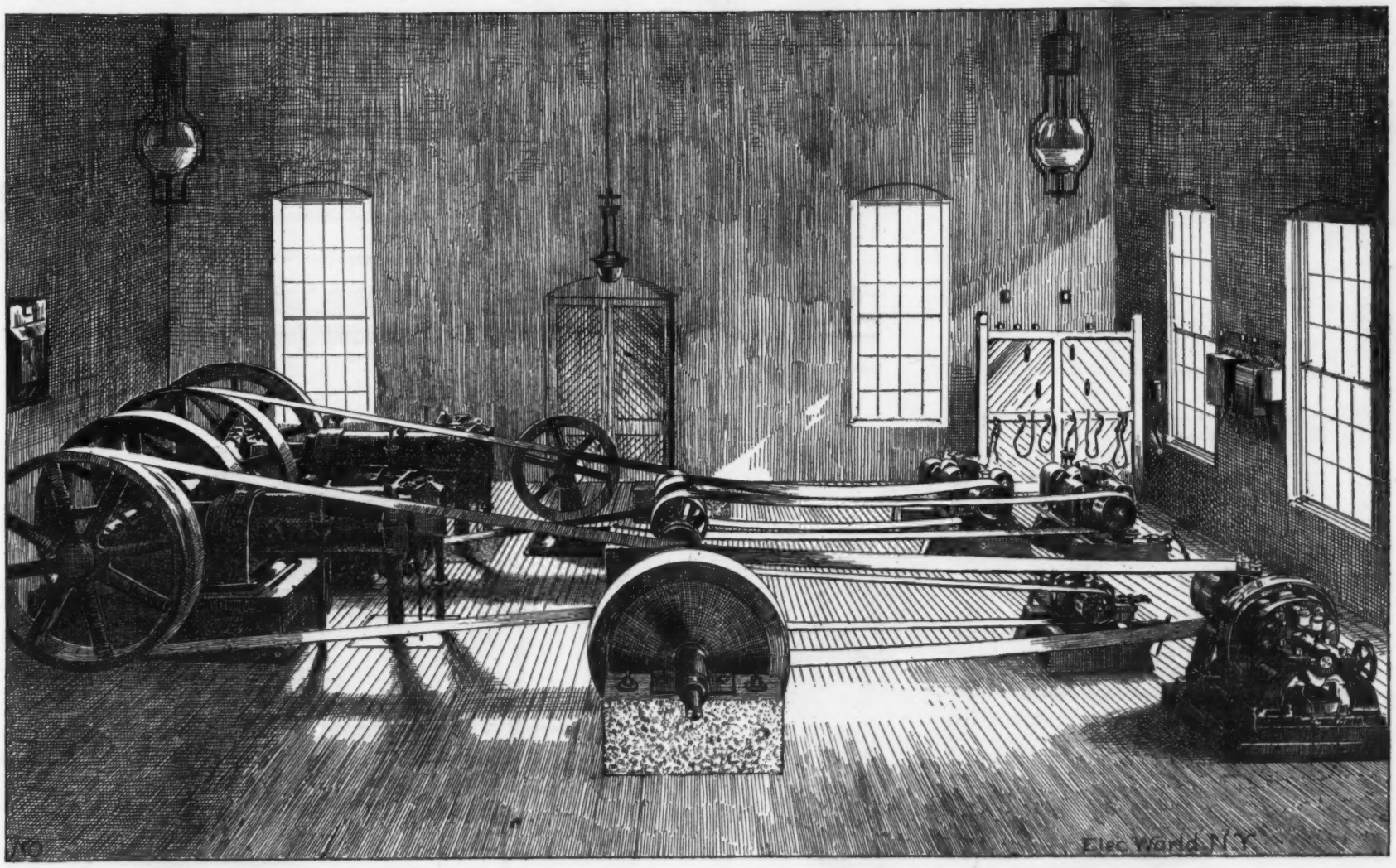
The illustration on this page shows an interior view of an electric light plant operated in this way by the Woonsocket Gas Company, at Woonsocket, R. I. The building is on land owned by the company, is near the coal gas plant, and adjoins the building containing the water gas plant. It is one story in height, 60 × 45 feet, and is built of brick. The main floor is divided into four rooms.

he engine and dynamo room, containing the motive power and the electric machinery, is 45 × 50 feet. Besides this there are a workshop 9 × 18 feet, a storeroom 9 × 13 feet, and a toilet room. All the rooms are well lighted and are sheathed with hard pine.

The motive power is furnished by two 50 h. p. Otto gas engines, built by Schleicher, Schumm & Co., of Philadelphia, Pa. Each engine weighs about 10 tons, and the fly-wheels not far from 3,800 pounds each. The crank shafts are Bessemer steel, and were constructed at the Krupp works, Essen, Germany. They are 5½ inches in diameter and 5 feet 4 inches long. The fly-wheels are 72 inches in diameter. The engines are belted to countershafts from which belts are run to the dynamos. On the countershaft from which the incandescent light dynamo is operated is a heavy balance wheel, but this has not been needed in the operation of the arc lights.

The electrical equipment consists of two Brush arc dynamos with a capacity of thirty 1,200 candle power lights each, and one 600 light alternating incandescent dynamo and exciter. These machines, together with the two engines, countershafting and arc light switchboard, are all shown in the illustration. A new switchboard, made of slate with marbleized face, for the incandescent circuit, is about completed. Another incandescent and another arc machine are soon to be added and this increase will also necessitate the addition of one or two new gas machines, and for these the foundations are already in place.

The gas engines in this plant when fully loaded consume about 1,100 cubic feet of water gas per hour each. This is about equivalent to two pounds of coal per horse power per hour. The economy as compared with steam power will, of course, depend upon the facilities of the gas works for producing gas and upon the system in use,



CENTRAL STATION OPERATED BY OTTO GAS ENGINES.

Test of a Domestic Lighting Plant.*

BY ED. C. DE SEGUNDO.

In February last year I put up a complete plant for lighting my house by electricity. The house is a small one, and 30 eight candle power lamps suffice for all my purposes. A half-horse power nominal "Otto" gas engine drives a 1-kilowatt shunt-wound Statter dynamo, which charges an accumulator consisting of 16 11-L. E. P. S. storage cells (1888 pattern). On the switchboard the usual provision is made for switching end cells in or out of the charging or discharging circuit. Means are also provided for measuring the current and the electromotive force.

As trials of so small an installation are not numerous, it occurred to me that an account of a trial I made a few days ago, which was carried out on purely commercial lines, might not be altogether without interest. The fact should be borne in mind that the conditions of the trial were not those obtaining in a laboratory. The gas engine had not been cleaned or overhauled for the occasion, the slide had been running for about 25 hours since last being cleaned, the cylinder had not been touched for over a year, nor were any extraordinary precautions of any kind taken to ensure good running or high efficiency—in fact, the condition of things may be perhaps best summed up in stating that the cells required recharging in the ordinary course, and that I took this opportunity of finding out what my electric light was really costing.

As I pay for my gas through the company's meter, I measured the gas consumption by this meter, and did not use any special type.

The quantities measured were:

(1) Gas.
(2) Potential difference at the terminals of the dynamo.
(3) Current flowing in the external circuit.
(4) Speed of engine.
(5) Speed of dynamo armature.

The instruments used were an Evershed gravity voltmeter and gravity ammeter. I checked both instruments before using them as well as I could, and found that the voltmeter read too low. I could not determine the coefficient of error with great accuracy, but as well as I could ascertain it I found that about two volts should be added to the mean reading. The ammeter was very fairly correct.

The engine was started at 5:20 P. M., but regular readings were not taken until 6:7½ P. M. The voltmeter and ammeter were read every 10 minutes, the engine and armature speeds being taken at the same time intervals, until 6:59½, when I was obliged to leave home. I got another set of readings at 8:25, and another at 10:1 P. M. As under ordinary circumstances the engine runs without skilled attendance, I did not touch the brushes during the whole run. This, of course, accounts for the speed of the engine increasing as the cells became charged.

The measurement of the gas consumed is important, and I may just point out how the meter readings were obtained. The meter registers 100,000, 10,000, 1,000 and single cubic feet. I therefore timed the speed of revolution of the small hand marking cubic feet, and found that a little less than two complete revolutions were made in five minutes. Thus I was able to read it every ten minutes by noting the lag behind a complete revolution. To prevent magnetization of my watch, I took the revolutions of the armature per 180 revolutions of the engine, and, immediately after, timed the speed of the engine per minute. The slip of the belt may, I think be reasonably taken as constant over the period of regular readings, so that the armature speeds were indirectly obtained quite accurately. The observations are given below.

ELECTRICAL READINGS.

Time.	Volts.	Ampères.	Sp. gr. of solution in cell No. 6.
6.7½	34.6	13.95	1,190
6.17½	34.9	13.50	....
6.27½	34.9	13.70	1,191
6.37½	34.9	13.60	....
6.47½	35	13.50	....
6.57½	35	13.00	....
8.25	35	13.00	1,193
10.1	36	12.80	1,195
Mean values from 6.7½ to 6.57½:			
	34.9	13.54	
+ Correction:	2.0		
	36.9		

Everything happens as one would expect. The E. M. F. rises gradually, the specific gravity of the solution also rises, and, after a while, there is an appreciable diminution of the ampères. The speed of the engine rises, as the brushes are not shifted to suit the decrease in the effect of cross-magnetization owing to the strengthening of the fields and to the decrease of current flowing in the armature.

This value of the E. M. F. (36.9) is probably very near the correct one. I took the E. M. F. of the cells with a voltmeter specially arranged for this purpose, and found an average E.M.F. of 2.3 volts per cell.

SPEEDS OF ENGINE AND DYNAMO.

Time.	Revolutions of armature per 180 revolutions of engine.	Revolutions of engine per minute.	Revolutions of armature per minute.
6.11½	1,383	—	—
6.13	—	183	1,406
6.21½	1,385	—	—
6.23	—	185	1,423
6.31½	1,385	—	—
6.33	—	185	1,423
6.41½	1,383	—	—
6.43	—	185	1,420
6.51½	1,385	—	—
6.53	—	183	1,406
8.27	1,401	—	—
8.28	—	189	1,471
10.1	1,476	—	—
10.2	—	192	1,574

The ignitions of the gas engine were quite regular throughout.

GAS METER READINGS.

Time.	Revolutions of the small hand indicating 2 cu. ft. per revolution.	Differences.
6.9¼	0.00	3.97
6.19¼	3.97	3.91
6.29¼	7.88	3.92
6.39¼	11.80	3.92
6.49¼	15.72	3.77
6.59¼	19.49	....

Mean revolutions of small hand per 10 minutes = 3.9 nearly.

*A letter to the editor of *Industries*, London.

From these results the following is deduced:

Gas consumed per hour, 46.8 cubic feet,
Costing at 2s. 6d. per 1,000 cubic feet, 1.41d.
Volts at dynamo terminals = 36.9 volts.
Current in charging circuit = 13 54 ampères.
Watts through cells = 499.6 watts
(or, say, half a kilowatt).

Hence:

Cost of gas per kilowatt, 2.82d.

The allowable discharge rate of my cells is 22 ampères. I rarely discharge higher than 5 ampères; hence it may reasonably be assumed that the cells are about 90 per cent. efficient. This is further borne out by observation and experience of their working over a long period. Supposing them to be 90 per cent. efficient, the cost at the lamp terminals would be $2.82 \times \frac{10}{9} = 3.13$d.

To this must be added a proportionate amount for oil and waste. This item amounted in the last year to 41s., owing to the high class oil necessary for the engine.

Now, at a very liberal allowance, the lamp hours for the past 12 months have been 9,000. Assuming the lamps to be 35-watt lamps, this is equivalent to 250,000 watts produced by the machine—allowing for counter-efficiency of the cells.

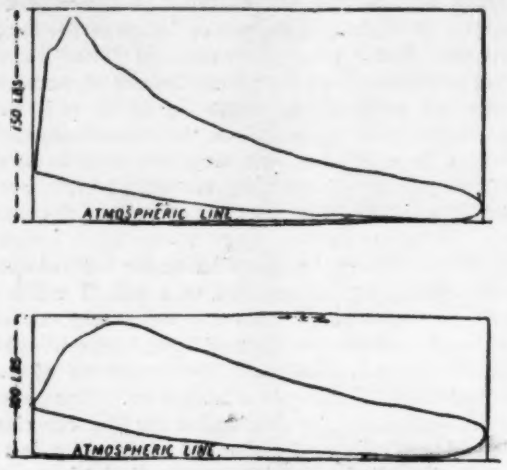
There is very little doubt that the oil has been far too plentifully used by my servant, whom I have always warned against letting the engine slide run dry. However, taking the figures as they stand, we must add

$$\frac{41 \times 12}{250} = 1.96\text{d.}$$

to the cost of production per kilowatt. This is a large item, being 41 per cent. of the total cost of production, which now becomes 4.78d., or, say, 4¾d. per kilowatt.

No allowance has been made for attendance, depreciation, etc. It would be difficult to estimate this in my case, but it should be borne in mind that some further amount should really be added to cover this.

It may be of interest to compare the working of the gas engine. The engine is 5½ years old, and was second-hand when I bought it. I indicated it some months ago, and also measured the brake horse power by a rope brake, similar to that used by Professor Kennedy at the Society of Arts trial last year. Inasmuch as there has been no indication of any alteration in the performance of the engine since then, it may, I think, be fairly assumed that these measurements represent very nearly the actual state of things. I took a good many cards. One is shown in Fig. 1, taken at full load. Fig. 2 shows a card taken when the engine was simply driving itself.



FIGS. 1 AND 2.—INDICATOR CARDS.

The i. h. p. was:

Full load	1.8
Running light	0.51

The brake trial gave the following results:

Weight on brake	15 lb. 14 oz.
Mean reading of spring balance	2 lb. 2 oz.
Mean revolutions per minute	184
Periphery of fly-wheel	131.88 in.

Ignitions quite regular.

$$\text{b. h. p.} = \frac{13.75 \times 131.88 \times 184}{12 \times 33{,}000} = 0.84$$

Thus it seems to make some difference—at least to a gas engine—at what rate work is absorbed in internal friction when running light and when running with a load on.

We can also from these results get a rough idea of the efficiency of the dynamo:

0.84 b. h. p. = 627 watts;

therefore commercial efficiency of dynamo

$$= \frac{500}{627} = 79 \text{ per cent.}$$

$$\text{electrical efficiency} = \frac{500 + \left(36.9 + \frac{36.9}{53}\right)}{627}$$

= nearly 84 per cent.

(the resistance of the shunt bot being 53 ohms. The armature resistance is so small that the energy lost in it may reasonably be neglected in so rough a calculation).

These efficiencies are certainly good for so small a machine, and the performance of the gas engine is also very creditable—viz., 26.1 cubic feet of gas per i. h. p. per hour. But, of course, I cannot claim scientific accuracy for these figures, as the company's meter may be wrong.

Improvements in Double Trolley Systems.

In systems of electric locomotion that employ two overhead wires and trolleys having their wheels mounted on outwardly projecting axles, there has been much difficulty experienced in retaining such trolleys in position on the wires. We give on this page illustrations of several improvements in such systems which have recently been patented by Mr. Frank Wheeler, of Meriden, Conn. In Mr. Wheeler's first invention in this line (Fig. 1) a bar of wood carries two hangers, separated from each other and having diverging feet with clips for the two conducting wires, which also serve as the track for the two-wheeled trolley; this trolley consists of two plates connected to and insulated from each other under the conductors, and carrying flanged wheels extending in over the conductors; the arms which swing from the axles of the wheels, and form a bail-like draft loop with insulating material between their lower ends, form the means of connecting with the car motor.

The trolley is applied to or removed from the conducting wires by pressing the latter together at points between two pairs of hangers, and allowing them to pass between the inner ends of the wheel axles. In no other way can the trolley be removed from the wires, except at the end of the track, and it is therefore found in practice to be particularly useful in mines where the frequent tortuous arrangement of the conductors would ordinarily cause frequent dislodgment of the trolley.

In the Hocking Valley mines of the Ellsworth & Morris Coal Company this trolley is in use in situations where the gallery is low and narrow and the conductors are strung part of the way on one side and part on the other side; consequently the trolley is drawn by the motor car from side to side, but without failing to run smoothly and continuously.

Fig. 2 illustrates a four-wheeled trolley having a similar arrangement of the wheels, and in which the draft occurs at a point about midway between the two pairs of wheels, the connection of the draft cord being through a swiveled arm. This arrangement gives a steadier motion of the trolley.

Mr. Wheeler's next step was to devise switches and turntables suitable for his trolley, and the chief object of his switch, shown in Fig. 3, was to avoid short-circuiting when the ends of the switch track rods pass from one branch pair of conductors to the other, and yet to have close contact between the ends of the rods and the clips to which the ends of the wires are secured. This is accomplished by causing the ends of the rods to rise and then fall in their passage across.

The pivoted ends of the switch rods are slightly loose in their sockets, and near their other ends are supported by a hanger which carries a roller and guiding block at its upper end. The roller rests in one of two recesses in a horizontal fixed guide when the ends of the rods are in contact with the clips of one pair of branch conductors, and when the rods are to be switched to the other pair of conductors a pull on the proper cord connected to the axle of

FIG. 1.

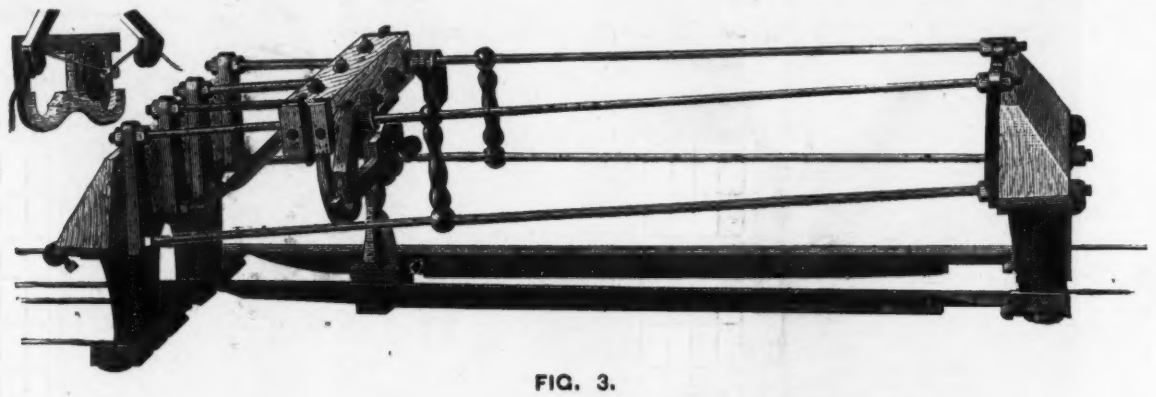


FIG. 3.

FIG. 2.

FIG. 4.

IMPROVEMENTS IN THE DOUBLE TROLLEY SYSTEM.

the roller causes the roller to rise out of the recess, travel over the horizontal portion of the guide, and drop into the other recess, carrying the hanger and the switch rods with it. The horizontal portion of the guide is sufficiently higher than the bottom of the recesses, as shown in the small detached view in Fig. 3, to prevent short circuiting or sparking when the ends of the switch rods pass the clips of the conductors. Another device of Mr. Wheeler, for the combination of a car track switch and an overhead conductor switch, with connections whereby the movement of one switch will simultaneously operate the other, shows this rising and falling conductor switch, and also provides means for operating both switches from the car while in motion.

In Figs. 3 and 4 a small diagonal strip will be noticed, held by a screw in a recess of the hanger clip or arm; behind this strip the conductor wire is bent on an angle and then horizontally under the clip, the strip securing it in position.

Fig. 4 illustrates a turn-table switch or crossing for this system of conductors and trolleys; it consists of a frame having the separated hangers secured to it in the desired relative position, and a table hung from above in a suitable bearing in the centre of the frame, and having two tracks. An arm extending from the upper end of the axle of the table has a cord or cords connected to it for operating it in case of one cord being used, a spring causes the reverse motion.

The table tracks are in the plane of the conductors, and in turning do not rise, as in the form shown in Fig. 3, for the reason that, in switching or turning, when one end of a switch track passes a live wire the other end is out of position to complete a circuit. The construction shown in Fig. 4 is designed chiefly for a crossing, but can be used as a switch if the trolley is stopped on the table tracks and the table then turned. Any number of conducting wires may lead to a frame made of sufficient size.

In the summer of 1889 the first of the two-wheeled trolleys were introduced on a short line at Reading, Pa., by the Philadelphia & Reading Railroad, and later by the Ellsworth & Morris Coal Company in mines in the Hocking Valley, Ohio.

At the refining works of the California Sugar Refining Company, San Francisco, on a somewhat complicated system in which ten switches and four turn-tables are used in about a mile of tracks, the Wheeler devices, including a number of trolleys, are in practical and successful use, while the Equitable Electric Railway Construction Company, of Philadelphia, is at present having orders filled for the same devices. At the mines referred to, where the trolley would at times be running almost at a right angle to the motor car, the four-wheeled trolley was found to be better than the two-wheeled, and to run successfully regardless of awkward situations.

Recently Mr. Wheeler has made some further improvements in his system. One is a combined car track switch and overhead conductor, and the trolley switch already referred to; another is chiefly for a construction of the turn-table switch whereby on a single track railway having turn-outs each car may carry its own trolley from end to end without disconnection. In such lines it has been customary for two cars passing at a turn-out to exchange trolleys. The device referred to discloses means whereby the trolleys of a double conductor line are automatically switched to their proper wires of an overhead conductor turn-out.

A patent issued to Mr. Wheeler July 1, and shown in our record this week, is for a system in which the trolley track is arranged at the side of the street and swings on a main supporting and conducting wire, the whole being protected by a shield for preventing contact with other wires.

Another patent of this date is for a tubular conductor, having two inwardly curved, concave conducting tracks, which have a uniting and protecting arched shield, and in which the wheels of the trolley, having rounded peripheries, run; but in this system the wheels are mounted on axles that project outwardly from a single frame that extends down through the longitudinal opening between the two conducting tracks.

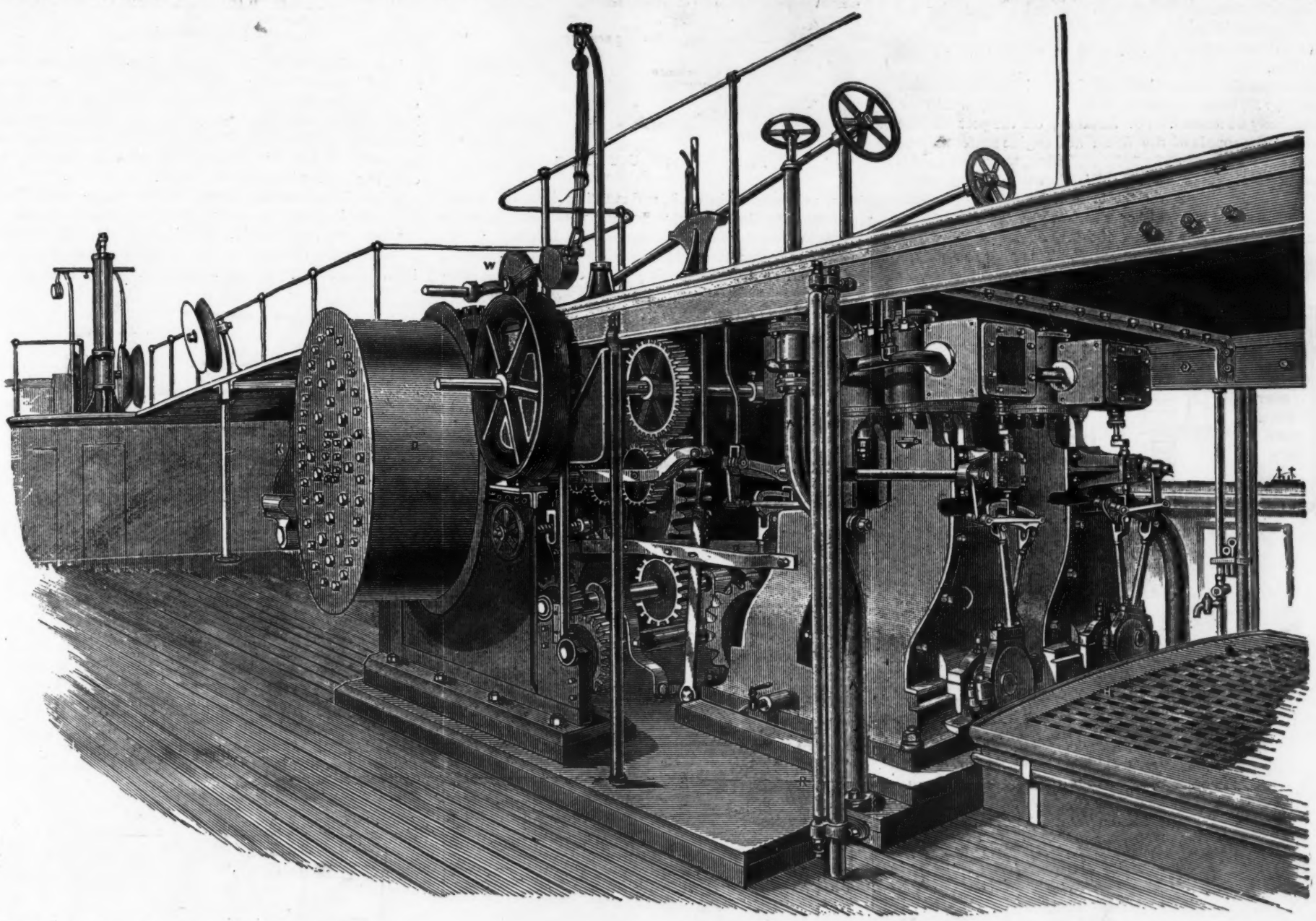


FIG. 1.—PORT CABLE GEAR OF THE STEAMSHIP "JOHN PENDER."

Improvements in Cable Ship Gear.*

BY H. D. WILKINSON, M. I. E. E.

In the operations connected with submarine cable repairs it has been found of considerable convenience and advantage to have independent control over the picking-up and paying-out gear on board ship when these two operations are carried on simultaneously over the bows.

During repairs, except for very long lengths, it is now the usual practice to pay out over the bows, and when the fault has been removed and the ship has payed out up to the buoyed end to make the final splice, the double operation has to be performed of picking up the rope by which the cable has been moored, and paying out on the repaired end. In ships provided with only one drum forward, it is customary to wind the mooring rope round the drum in the opposite direction to that in which the paying-out cable is wound, so that the one drum performs both operations. This has the disadvantage that as much slack cable is payed out as the length of the mooring rope, which, in deep water, entails the laying of considerably more slack than necessary. To avoid this loss the payed-out end may be made fast; but this is not satisfactory, as the strain on the cable is always great, and may increase rapidly at any moment as picking-up proceeds. In some ships, such as the steamship "Electra" (Eastern Telegraph Company), there are two drums, either of which can be thrown in or out of gear. With this arrangement the drum used in paying-out is coupled to the train of gear driven by the engine until arrival at the buoy, when it is held and controlled by a powerful brake, and thrown out of gear with the engine. The latter then drives the other drum, and hauls in the mooring rope. As the strain increases, the brake is partially released, allowing the drum on the paying-out side to slip and pay out slack to relieve the strain. By this means there is no unnecessary slack payed out. An improvement on this is to provide two independent trains of gear, each with its own drum and driving engine. This has been done in the cable ships "Amber" and "John Pender" of the Eastern Telegraph Company, the engines being horizontal, and the gear designed and fitted by Messrs. Clark, Muirhead & Co., in the case of the steamship "Amber," and the engines vertical, and gear designed and fitted by Messrs. Johnson & Phillips, in the steamship "John Pender." It is of the gear recently fitted on board the "John Pender" that this article is descriptive.

By reference to the perspective view of the gear (Fig. 1), it will be seen that the starting valves of the two engines and their reversing gear are operated from the bridge. From this platform also the brakes on the respective drum shafts are controlled and the jockey pulley thrown in or out of gear. The other changes in the gear are made below the bridge as required. In this view it will be noticed that the hatch opening on the main cable tank is situated close to the gear at *H*, the ship having two more tanks forward and one more aft. During paying-out, the cable is drawn up from the tank by the jockey wheel and pulley shown at *W* and *P* respectively; the traction or hauling power on the cable being regulated by the weight on the lever carrying the jockey wheel. The cable passes through an iron eye in the centre of the hatchway above the tank, round the outside of the vertical roller *R*, over the jockey pulley *P*, and three times round the drum *D*. Thence it is led forward over a guide pulley, under the dynamometer pulley, over a second guide pulley, and over the bow sheaves. When paying out from the aft tank guide pulleys are laid at intervals along the deck to guide it to the jockey and drum. The spindle carrying the jockey pulley carries also a brake wheel, the friction on which is maintained by a lever and weight.

Between the drum and engine shafts there are three intermediate shafts for reducing the speed. These run athwart ships parallel to the drum shafts, and are num-

* From the *Electrician*, London.

bered 1, 2 and 3 on the plan (Fig. 2) for reference. The engine shafts are fore and aft, and drive by bevel gear on to the first shafts in the train of gear, but can be uncoupled when required by shifting the bevel on the engine shaft. The port and starboard No. 1 shafts can be coupled together by the central coupling C if required; thus both trains of gear can be run by one of the engines, and this can be made to operate either or both drums. For this purpose the cog wheel driving that on the drum shaft can be shifted along a feather on No. 3 shaft, so as to disconnect the corresponding drum from the gear. On No. 3 shaft is keyed a small spur wheel *J*, operating the jockey pulley spindle. This gear is best seen in Fig. 3, in which the spindle is at *A*, and has keyed to it a spur wheel, as shown. When the lever *T* is vertical, this wheel is thrown into gear with the shaft at *J*. To uncouple the pulley from the gear, the pin at *a* is removed and the lever *T* let down. This is required when paying out with the brake on the drum only; the pulley is then free from the train of gear, and revolves by the friction or weight of the cable passing over it. The object of this pulley being to guide the cable to the drum, the shaft on which it is mounted projects by the width of the drum, and the pulley (which slides on a feather) can be made fast by a set screw in any required position.

Between the first and second shafts of the transmission (see Fig. 2), there is a single and double gear by which the speed may be altered. For instance, on the port side the ratio of the speeds of the drum and engine shafts may be either as 6 : 100, or as 3 : 100, according to which gear is used. The type of brake used is shown in Fig. 3, where *W* is the hand-wheel on the bridge, by which one of the brakes is adjusted. This operates a right- and left-handed screw, gripping or releasing the brake. In this figure the speed counter gear is shown at *S*. This is operated by a lever *L*, fulcrumed on the fixed arm *M*, which receives an upward movement every revolution by the pin *p* attached to the cog-wheel on this shaft. This movement affects the speed counter through the arm *C*. The drum has a circumference of 18 feet, and therefore 30 fathoms of cable are payed out for every ten revolutions. For keeping the turns of cable in the centre of the drum the knives shown in Fig. 4 and at *K* in Fig. 1 are provided. These can be adjusted in position with respect to the drum face so as to prevent banking up against the cheeks of the drum and overlapping.

The engines are by Messrs. Robey & Co., and, as will be seen in the engraving, are double cylinder verticals. The support to the cylinders in each engine is in two castings, bolted together with front and back plates, forming a hollow framework, in which the crank shaft revolves in oil and water. This framework forms internally the guides for the crossheads, and to it are bolted externally the brackets for valve spindle guides and reversing gear, the links and eccentrics for the latter being outside. The vertical space occupied by the engines and gear between the main deck and bridge is about 6 feet 6 inches, the stroke being 15 inches. Sight-feed lubricators are fitted to each engine. The holding-down bolts are secured underneath the deck, which is of iron, by 8-inch baulks of timber and large plate iron washers.

The steam pipes are at *A A*, Fig. 1, being connected together underneath the deck, and running into the steam pipe supplying the forward winch and windlass. Immediately below the deck a steam separator is inserted in the steam pipe, from which a 1¼-in. drain pipe is led upwards, as shown in Fig. 5. The drain pipe is carried along horizontally at the height of the bridge to the engine room, where it is dropped and connected to the main boilers through check and stop valves, as shown. This returns all water drained from the separator direct to the boilers, the action of the apparatus depending on the increased pressure due to the height of water in the vertical portion of the piping dropped to the boilers. It appears strange at first sight to see a drain pipe from a separator carried upward instead of downward, and still more so to see that there is sufficient pressure to return water to the boilers; such is, however, the case, as may be noticed at any time by shutting the stop-cock at the boiler. The accumulated water then rises in the pipe, and may be noticed at the gauge glass *G*, instantly descending and entering the boiler on re-opening the stop-cock. The system is an American patent worked by the "Steam Loop and Separator Company," and appears to be of considerable utility in providing dry steam to engines situated at a distance from the boiler. At sea there is the additional advantage of economy in fresh water. The separator is of special construction. Steam passing through it is checked in its course by striking against a set of vertical combs, so arranged that the steam pursues a zigzag course between them. In so doing it delivers up its moisture, which runs down the combs, and through holes into the drain below. The Edison electric light station at Chicago has this system installed with the best results, and it seems not improbable that it may prove of great service to electric light installations, where trouble is experienced from condensation in steam pipes and cylinders.

When cable is payed out over the stern sheaves it is passed under the dynamometer pulley, as shown in Fig. 6, and the brake on the paying-out drum shaft is regulated so that the indicated strain is maintained as even as possible. As the brake is regulated on the bridge platform, it would be an advantage to indicate the strain somewhat nearer the bridge, either actually or by transmission. The new gear described above has been designed to sustain a strain of 25 tons, acting in a direct line from the drums. This is considerably above what is usually met with in cable work, and the gear is, moreover, capable of bearing double that strain, so that an ample margin is provided for.

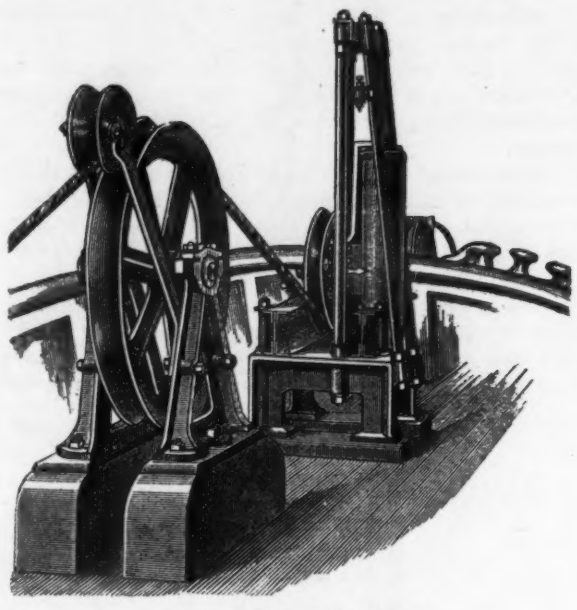


FIG. 6.—PAYING OUT CABLE.

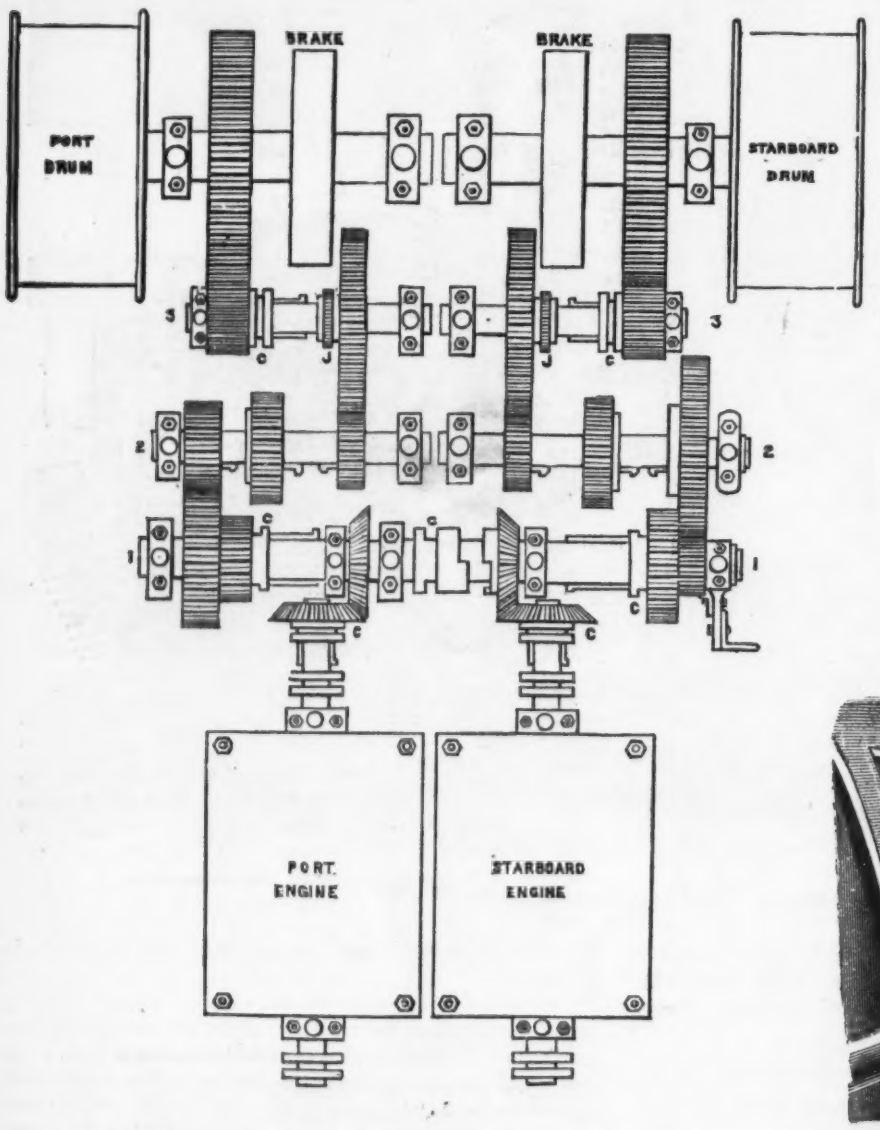


FIG. 2.—PLAN OF PAYING-OUT MACHINERY.

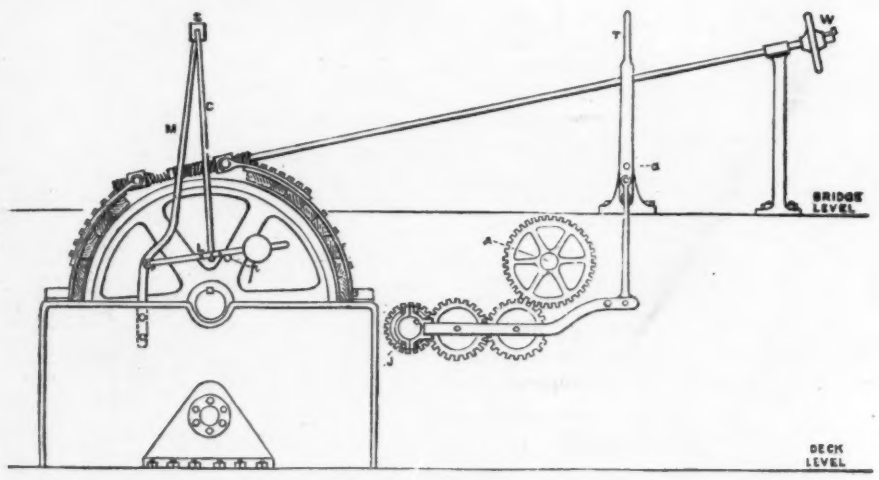


FIG. 3.—ELEVATION OF BRAKE AND HAULING GEAR.

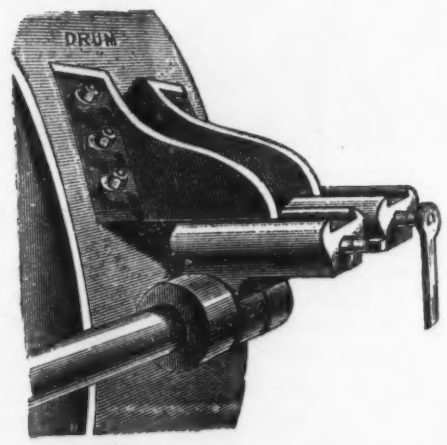


FIG. 4.—BLADES FOR STEADYING CABLE.

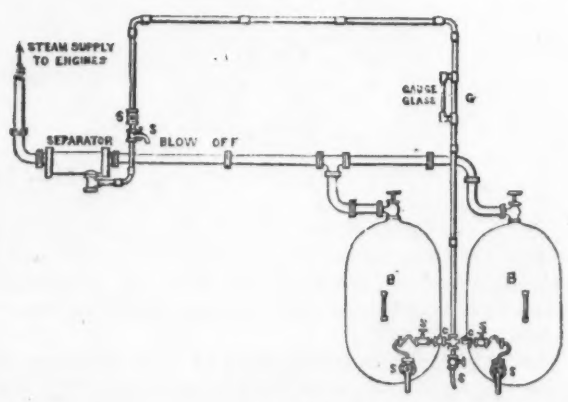


FIG. 5.—SEPARATOR.

Seeing by Electricity.

It is said to be possible that modern electricians may succeed in constructing a device that will do for the sense of sight what the telephone does for the sense of hearing; but the prospects of such an achievement are not particularly bright. The possibility has been demonstrated experimentally, but the practical difficulties in the way of carrying out the idea are very great.

It is well known that certain salts of copper and silver, for example, generate electric currents when exposed to the light, and, conversely, electric currents will produce in these salts changes corresponding to those made by ight. If a strongly illuminated object is placed in front of a transmitter covered with such a salt, electrical currents will be generated which will vary in intensity according to the intensity of the light falling on different parts of the surface. If, now, these various currents were carried to a receiver similar to the transmitter, they would produce on its surface changes like those wrought by light on the surface of the transmitter.

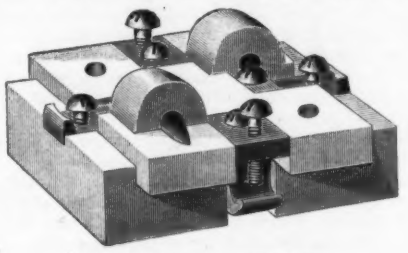
Another apparatus has been proposed, based upon the property peculiar to selenium that its electrical resistance changes with the intensity of light. For a transmitter, the selenium cells are arranged in squares, like a checkerboard. The greater the number the more efficient would the apparatus be. Each of these is connected with an electro-magnet in the receiver. The latter is composed of a mirror constructed of thin strips of steel, to each of which several of the electro-magnets are attached. A strongly illuminated body being placed in front of the selenium transmitter, the electrical resistance of the various cells varies according to the intensity of the light, a

in the case of the salts of copper and silver. The various currents affect the electro-magnets in different degrees, the result being that the strips of steel are bent irregularly, turning the mirror into an aggregation of surfaces, very slightly warped, which will throw an image on a screen.

The main difficulty in the way of the realization of such an idea as seeing by electricity lies in the necessary complexity of an apparatus which shall enable innumerable points in the transmitters and receivers to be actuated simultaneously in perfect independence and also in perfect correspondence; but it is quite possible that further experiment will bring into actual use what might be something more than a mere plaything. In defensive warfare a telescope of indefinite length would certainly be of value. With buried wires and concealed visors a general might watch his adversary's movements at times when this would mean victory instead of defeat.

A New Branch Cut-Out.

The accompanying illustration shows the Cutter branch cut-out, a novel specialty now being put upon the market by the Great Western Electric Supply Company of Chicago.



NEW BRANCH CUT-OUT.

It consists of a peculiarly-shaped porcelain base and four brass connecting-pieces. The brass pieces are set into recesses in the porcelain, two of them clamping a reduced section of the porcelain, and all four being firmly held by single screws from below. The screws go in far enough to admit a thick insulation coating between them and the back, so that the block may be safely set against a damp ceiling. The wires are readily fastened without removing any screws. Neither the main nor the branch wires need be cut, but are merely bared opposite the fastenings, and, owing to the shape of the porcelain block, the main and branch wires can never touch each other. As common screws are used throughout, any one lost can be readily replaced.

These features will commend themselves, but perhaps a still more novel one is that of a bridge covering the central portion of each fuse. The fuse is easily put in place, and when it burns out the bridge restrains the sputtering and catches the burnt metal. Thus the bridge gives the effect of a cover, although fireproof, neater and cheaper. The whole is strongly made, nearly twice the size of the cut, and suited for 20 ampères or less.

The Hamon Friction Gear for Driving Dynamos.

Among the different systems for the transmission of power in electrical installations, either public or individual, many objections are constantly found to the usual method

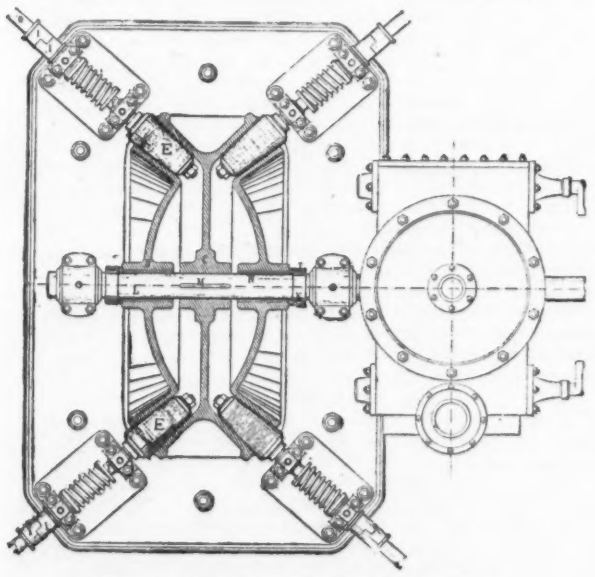


FIG. 1.—PLAN OF HAMON GEARING.

of employing belts or cables. The cable, indeed, has been entirely abandoned in this country, and is but little used anywhere. The transmission by means of belts is evidently the most elementary method and that which naturally suggests itself when it is necessary to communicate the rotary motion of one shaft to one or several other shafts. Everyone knows the serious inconveniences inherent in this system in spite of its apparent simplicity. If the belt is is too loose it slips, and the machine turns to almost no account; whereas, upon tightening the belt to overcome this difficulty, there is a strain put upon the bearings which results in loss of both power and life. Direct coupling of steam engine to dynamo is ordinarily objectionable owing to the vastly different speeds at which it is desirable that these be run.

The most desirable method of actuating a dynamo from steam engine seems to be that of using frictional surfaces. *La Lumière Electrique* of June 21 gives a description, with illustrations, of the device of M. A. Hamon for adapting friction gearing to the actuating of a number of motors from the one engine. M. Hamon couples the dynamos directly to the motor and obtains by his method the respective speeds of the engine and the dynamos needed for the best effect of each. The space occupied by the driving machinery and four motors will be seen from our illustration (Fig. 2) to be very much reduced, and in every way the invention seems an admirable one.

In Fig. 1 is given a diagram of the gearing. *C* and *D* are two cones, the one within the other, having the same theoretical apex, and revolving in opposite directions. These two cones have a weight sufficient to replace that of the ordinary fly-wheel. The dynamos, instead of using pulleys, have their armature shafts extended between the surfaces of these two cones at *E* and E_1; it is evident that when *C* and *D* revolve in opposite directions there is neither slip nor friction at *E E*, nor is there any tendency to throw out of alignment, nor any consequent wear upon the bearings, which have simply to support the weight of the armature shaft. The cones on the dynamo shafts are made of compressed paper, and may be replaced at almost no expense when they eventually wear out. It has been found in practice that no great pressure is needed between *C* or *D* and *E* in order to produce the necessary revolution without slip. This is a considerable gain in power. As to possibility of slip, this is absolutely reduced to a minimum, even under conditions of great variation of the work demanded of the dynamo, because the adhesion between *E* and *C*, *D* is upon lines of surface contact which may be

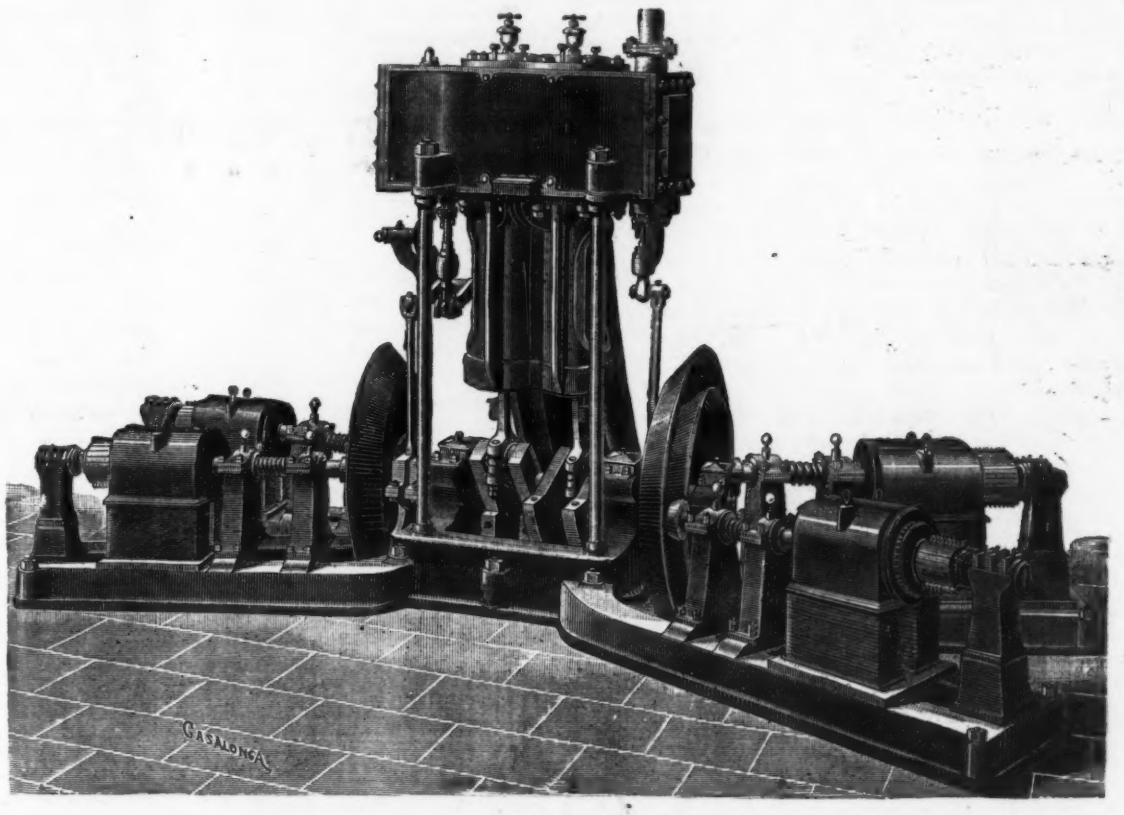


FIG. 2.—HAMON FRICTION GEARING.

as long as is desired in constructing the machine. It is, of course, necessary that the right motion of *D* and the reverse motion of *C* be identical, but this is merely a mechanical detail.

M. Hamon has certainly devised a most excellent system for reducing to a minimum the difficulties of speed that are met with in dynamos actuated by steam engines, and also for concentrating a number of dynamos into the smallest possible space. His arrangement may, of course, be adapted to either two or four dynamos, and but trifling mechanical variations are necessary if it is required to drive more than four from the one engine. We shall hope to see these friction cones commercially introduced in this country at an early date.

The Bermuda-Halifax Cable.

Bermuda, now connected with the rest of the world by telegraph cable, is a group of islands lying six hundred miles east by south from Cape Hatteras, in latitude 32 deg. 20 min. north, and in longitude 64 deg. 50 min. west. There are two towns, St. George's and Hamilton, the latter being the centre of the colonial government. The whole population numbers about fifteen thousand, of whom about one-third only are whites. It is one of Great Britain's naval stations, having large docking facilities and ample plant for the repair of modern war ships.

The cable company is an English joint stock concern known as the Halifax and Bermudas Cable Company, Limited, its office being at No. 33 Old Broad street, London. The capital of the company consists of £170,000.

The steamer "Westmeath," which has just laid the cable, was fitted with the latest and most improved machinery for cable work. After landing the stores for the equipment of the Bermuda station, the "Westmeath" landed the shore end there and paid out a short distance seaward. The cable was then cut and buoyed and the cable ship proceeded to Halifax, taking soundings on the way. At Halifax, where the "Westmeath" arrived June 16, the northern shore end was landed, and the ship started paying out toward Bermuda on the 24th ult.

The cable consists of five sizes—the Bermuda shore end, about six inches in diameter; the Halifax shore end, two "intermediates," A and B, and the deep sea section. The cable conductor consists of a strand of seven copper wires, 120 pounds per knot, insulated with three alternate coatings of gutta percha and Chatterton's compound, 150 pounds per knot. This core is covered with a serving of jute yarn steeped in preservative mixture applied wet and then whipped with three-thread jute yarn to keep the serving in place. The deep-sea cable is served with 16 galvanized homogeneous iron wires. The "intermediate A" is sheathed with 12 No. 8 (B. W. G.) and "intermediate B" with 12 No. 5 wires. The shore end consists of "intermediate A" sheathed with 12 strands of three No. 6 wires. The whole of the above is served with two coats of Russian hemp, laid on in opposite directions, and three coatings of bituminous compound, the first of which is put on next to the wires and the others over a layer of yarn.

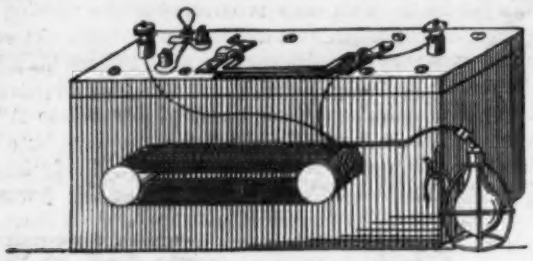
The approximate weight of shore end, "intermediate A," "intermediate B" and deep sea cables is 14, 5, 3 and 1 ton per knot respectively. The conductor resistance is 10.5 ohms per knot at 75 degrees Fahrenheit. The gutta percha resistance after 24 hours' immersion in water at 75 degrees is to be not less than 1,000 megohms per knot after one minute's electrification. The instruments to be employed are the modified form of syphon recorder.

The cable will be opened for general commercial business from 8 A. M. to 8 P. M., and the greatest amount of traffic is anticipated between New York and Bermuda. Arrangements are now being negotiated with all American, Canadian and European lines for a general interchange of business. The rate per word between Bermuda and Halifax will be 75 cents. The line is to be extended to Nassau and Jamaica, and thence to Progreso and Vera Cruz. Also a line will be laid from Bermuda to the Azores, and thence to Lisbon, Portugal.

Prevention of Accidents in Varnishing Casks.

The use of the electric light as a substitute for ordinary lanterns in places where explosive and inflammable gases are likely to be present is always to be commended. A echnical contemporary, referring to the inflammability of the alcoholic vapors discharged during the operation of varnishing the interior of beer casks, says that the lanterns which are used to furnish the necessary illumination of the interior of the casks are but a poor protection against accidents. In order to eliminate these dangerous features in cask varnishing, and also to furnish a better illumination for this kind of work, Gus J. Siebel, of Chicago, has brought out a little device which will be readily understood from the illustration on the next page. The essential feature of this apparatus is an incandescent lamp of eight or more candle power, surrounded by a strong iron wire frame which, while it does not obstruct the light, effectually prevents its breaking. The wire frame of the lamp is also provided with a hook by which it may be hung in the belt of the laborer or hooked into the wood of the cask or elsewhere. By means of a coupling the lamp can be readily disconnected and connected so as to allow its introduction through bung holes, etc. The necessary electricity to light the lamp is furnished by three cells of a storage battery contained in an oblong box about 6×7×15 inches, and weighing, lamp and all, about twenty-five pounds.

The box is provided with a convenient handle, binding posts to connect the lamp, and a switch allowing the lamp to be disconnected whenever the light is not needed. A long flexible cord containing the conducting wires gives free motion of the lamp, and while not being used the cord is wound on a reel on the side of the box. The storage battery will light the lamp for about twenty hours, and can be readily recharged at any ordinary dynamo at the expense of merely making the connection introducing the battery in the circuit. If there is no dynamo on the



PORTABLE ELECTRIC LAMP.

premises or near at hand, a small one capable of charging a storage battery of the above construction can be put in at a small expense.

The Preservation of Fermented Liquids by Electricity.

Dr. G. Foth has recently published the results of a very exhaustive series of experiments on this subject. His investigation led to the following conclusions:

1. Alternate electrical currents, which, when conducted through a liquid, do not decompose it, are not able to kill yeast cells suspended in the liquid. The electrical current, therefore, as such does not exercise an injurious effect on yeast.

2. This effect is first exercised when the liquid in which the yeast is suspended is decomposed by the electrical current.

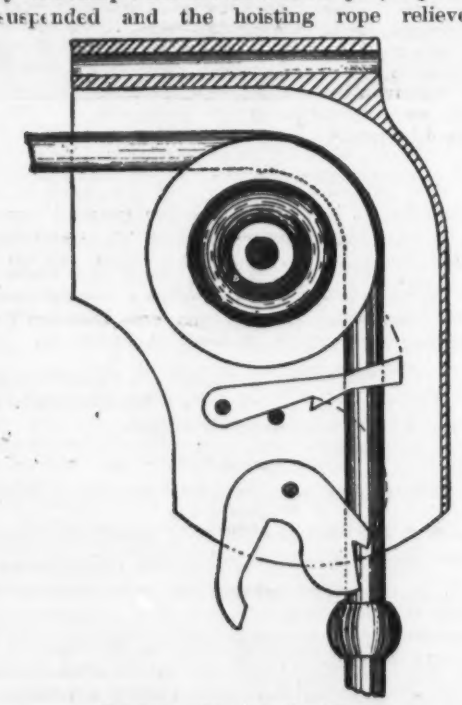
3. The ozone produced in the latter case is, if not the only, at all events the principal cause through which the death of the yeast is brought about.

4. The electrical current can therefore not be employed to kill the yeast in fermented liquids if their chemical properties are to remain unaltered. Electricity, therefore, cannot be used for the preservation of fermented liquids like beer, unless:

5. A higher temperature is brought about by means of alternate electrical currents; in fact, unless pasteurization is effected.

A New Suspension for Arc Lamps.

The Great Western Electric Supply Company, of Chicago, has recently placed on the market a pulley for suspending arc lamps which has several novel features. It is clearly shown in the accompanying illustration. It consists of a combination of a pulley and a locking device, whereby the lamp when elevated to its proper position is held suspended and the hoisting rope relieved of



PULLEY FOR ARC LAMP.

all strain Our cut shows the position of the parts when the lamp has nearly reached its proper elevation. If the lamp be raised a short distance more the knob on the rope engages the end of the swinging pawl, which is bifurcated, and causes it to revolve upon its axis. The lower or supporting pawl is then held securely in position by the upper pawl. When in this position the weight of the lamp is supported by the lower pawl. The release of the mechanism is effected by elevating the lamp until the knob on the rope engages the end of the upper pawl, which is thereby slightly raised, allowing the lower pawl to swing downward. This allows the lamp to be freely lowered. It will be seen that unlike many previous forms the locking and releasing of the support are both effected by the hoisting rope and no auxiliary cord is used.

An article of this kind will be appreciated by central station men who have suffered from the breaking of lamps by falling into the street when accidently or otherwise the rope has been broken or cut.

Power Required to do Various Kinds of Machine Work.

The following interesting and valuable table, giving the amount of power necessary to drive drills, planers, shaping machines, blowers, etc., under various conditions of operation, was compiled by Mr. Robert E. Dunston, president and electrician of the Connecticut Motor Company, Plantsville, Conn., and has been kindly furnished for publication:

(1) Shop shafting 2 3-16 inches by 180 feet at 160 revolutions, carrying 26 pulleys, varying in diameter from six inches to 36 inches, and running 20 idle machine belts, 1.32 h. p.
(2) Lodge-Davis upright back-grand drill press, having table, 28 inch swing, drilling three-quarter inch hole in cast iron, with a feed of one inch per minute, 0.78 h. p.
(3) Morse twist drill grinder No. 2, carrying 2½-inch wheels at 3,200 revolutions, 0.29 h. p.
(4) Pease planing machine 30 × 36 inches, table 6 feet, planing cast iron, cut ¼ inch deep, planing 6 square inches per minute at 9 reversals, 1.06 h. p.
(5) Shaping machine 22-inch stroke, cutting steel die, 6-inch stroke and ⅛-inch deep, shaping at rate of 1.7 square inch per minute, 0.37 h. p.
(6) Engine lathe, 17 inches swing, turning steel shaft 2⅝ inches diameter, cut 3-16 inch deep, feeding 7.92 inches per minute, 0.43 h. p.
(7) Engine lathe, 21 inches swing, boring cast iron, hole 5 inches diameter, cut 3-16 inch deep, feeding 0.3 inches per minute, 0.23 h. p.
(8) Sturtevant No. 2 monogram blower at 1,800 reversals, no piping, 0.8 h. p.
(9) Heavy planer about 28 × 28 × 14 feet bed, stroke 8 inches, cutting steel making 22 reversals per minute, 3.2 h. p.

The Infrequency of Deaths by Lightning.

It is probably idle to tell people that there is a thousand times the danger in the sewer pipes that there is in the thunder clouds, but it is true all the same. The deaths by lightning are few indeed. Who of the readers of this paragraph, says the Hartford *Courant*, ever lost a friend that way? Who of them hasn't lost a score of friends by the less brilliant and less noisy destruction that comes up out of the drains? The trouble with the lightning, or the trouble that it gives the people, is in its indescribable suddenness and its absolute uncertainty. You know neither when it is coming nor where it is going, all you feel certain about is that some storms leave a number of catastrophies to mark their course. The caprice of the lightning defies the explanations of science, and there is no predicting beyond a few generalities. This much it does seem safe to repeat, even in a lively lightning season, that the increased use of electricity, with the multiplicity of wires, has tended to fewer fatal strokes of lightning in cities.

Electric Lighting in the Railroad Service.*

BY M. B. LEONARD.

The extraordinary development during the past fifteen years of the art of lighting by electricity, and the success attending its daily use on our streets and in our houses, have been so apparent that its utility and benefits were quickly recognized in the railway service not only in this country but abroad, with this difference, however, that in the United States only the illumination of depots, yards and train sheds by means of the arc lamp was at first attempted, while abroad the lighting of trains and station houses primarily engaged the attention of the profession. Its progress, however, has been so great and its advances so manifest, that in this country our important trains are now lighted by electricity, and in Europe the arc light has been so extensively adopted that in one station alone of the Great Western Railway of England (Paddington) not less than 100 arc lamps are used, while the French, German and Italian railways are gradually lighting up the larger stations and yards in this way.

For many years one of the most prolific sources of injury to railroad men and loss to the company has been the switching of cars in the yards at night, with only a hand lantern to indicate the movements required. The engineer, owing to the darkness, was obliged frequently to depend more on luck than otherwise to guide him in handling his engine, the result being often a crushed hand or shoulder for the brakeman, if he escaped being caught between the bumpers; or the engineer miscalculating his distance in the darkness, would come back too hard, and thereby break the drawheads and smash in the ends of the cars.

The introduction of the arc light in the large yards where a great deal of switching or making up of trains at night is performed, was found, as had been expected, to work a wonderful improvement in this direction, and the use of the arc light for this purpose is now so widely extended, that there is scarcely a railroad from the Atlantic to the Pacific, which does not use the electric light in its important yards.

It enables yard and engine men to see one another almost as clearly as in sunlight, and, in addition to preventing accidents, permits the work to be done with almost as much dispatch as during daylight, while without the light double the amount of time would be required to perform the same service, and even then with less safety to machinery, cars and men.

An extended inquiry among the men using these lights develops the general belief that they pay for themselves several times over in the single item of repairs saved to rolling stock by enabling the engineers to do the switching more carefully, and with less damage to the cars. These arguments seem strong enough to warrant the use of electricity for this service, wherever the business is large enough to require night work.

Other important features in the use of the electric arc lamp are the greater amount of loading or unloading of cars that can be carried on at night, than with the oil lamp system, and the reduction of the number of car robberies and shortages in freight packages.

The experience of the Chesapeake & Ohio Railway Company at its Newport News, Va., terminus affords an excellent illustration of the benefits of the electric light in these respects. Through its connections with the Old Dominion Steamship Line from New York, large quantities of freight are transferred to cars at Newport News for Western points. As the New York steamers arrive at night generally, it is important that the freight be at once loaded, billed and forwarded with the utmost dispatch. Under the old oil lamp system it was found impossible to get the freight billed and cars loaded and started within less than 12 to 14 hours after the steamer's arrival. The number of claims for shortage and damage were very great, and reports of freight astray were numerous.

In the hope that this condition of things might be improved, a fifty arc light plant was put up, and the piers illuminated by electricity; immediately a new order of things prevailed, freight was billed and loaded correctly—there being no dark corners; the shortages and damage claims began at once to diminish, and the trains were forwarded in nearly one-half of the time it formerly required, while a substantial rebate was made by the insurance companies from the premium hitherto paid, which offset not a little of the cost of electric plant, and the reduction of the premium goes far toward paying the cost of maintenance and operation at present.

The lighting was extended to the immense coal piers of the company, and the coaling of steamships, which up to that time could be done very slowly, and only at great hazard during the night, was rendered almost as easy as in daylight. It is, therefore, safe to say that the Chesapeake & Ohio are satisfied with their investment; and that their experience is not exceptional is evinced by the fact of the Pennsylvania Railroad Company using no less than eighty arc lights on its coal wharves, yards, engine houses and depots in the city of Philadelphia.

While arc lights are usually designated as of 1,200 or 2,000 c. p., experience has shown that an arc lamp will give more light in some directions than others, and that while the use of globes very much diminished the intensity of the light, in certain cases they distributed it very much better.

For these reasons it is very difficult to determine just how many lights are necessary to illuminate a certain amount of space; frequently therefore, the best results could only be determined by a number of trials of the lamps in designated positions, changing them about until the desired results are obtained.

A series of experiments were recently instituted in Germany to ascertain the candle power of arc lamps, in which it was found that in a Siemens differential lamp, supplied with a current of 14 to 15 ampères at from 48 to 52 volts, the horizontal intensity was about 196 candles (German, very nearly the same as the English); it increased rapidly to about 20 degrees below the horizontal where it was 1,150 candles, then more slowly, until it reached a maximum at about 42 degrees below the horizontal plane, where the light was 2,014 candles; it then began to sink rapidly until below 60 degrees there was no light, but only shadow. The average intensity was 1,228 candles, with the globes on; the actual light obtained ranged from 510 candles downward to 1,183 in a direction inclined 40 degrees below the horizontal, with an average illuminating power of 834 candles when freshly whitened reflectors were used.

In this country the best results seem to be obtained from the 10-ampère long arc, or from 40 to 50 volt lamps set on poles 35 feet high, and from four to six hundred feet apart. The clear glass globes give the best illumination, as but few of the light rays are absorbed by the glass, but it is found that the unshaded glare of the arc is very trying to the eyes of the trainmen, and consequently the half-ground globes are preferred.

In examining the systems in use, it is found that the Thomson-Houston and the Brush are most preferred, though the Western Electric and the Janney are very popular in the West, while the new alternating system of arc lighting of the Westinghouse Company, owing to the greater life of the carbon, is making rapid strides.

A new and important improvement has recently been made in arc lamps which results in an enormous increase in the luminosity of the arc, and consequently a most brilliant and economical light.

This has been effected by making the lower carbon hollow and fitting it with a reservoir of oil and a wick, the oil ascending the wick by capillary attraction is converted into carbon vapor by the heat of the electric arc, re-inforcing the light of the arc by luminous particles of incandescent carbon, thereby increasing its brilliancy. The tests of this lamp recently made by Dr. Hopkinson, of London, show that the efficiency of the arc in watts per candle is nearly doubled, the color of the light being changed to a clear yellowish white, while the increased cost of the hollow carbon and the oil is so small that it is not worth mentioning, a single drop of the oil lasting nearly a minute.

It is claimed for this new lamp that it reduces the cost of arc lighting to such an extent that it is equal to gas at ten cents per 1,006 feet.*

Very little or no alteration is required to utilize this improvement in the present styles of arc lamps, and it is confidently expected that its adoption will soon become universal.

ELECTRIC LOCOMOTIVE HEADLIGHTS.

In still another direction the arc lamp will probably prove of great value to the transportation departments of our railroads.

For several years experiments have been carried on with the view to adapting the arc light for use in the headlights of locomotives. It was quickly ascertained, however, that the constant vibration of the locomotive seriously affected the feeding mechanism of the lamp, and consequently the brilliancy of the arc; but recently the improved feed apparatus and the adoption of a copper negative pencil instead of the carbon hitherto used, have been found to eliminate the difficulties, and the National Electric Locomotive Headlight Company, of Indianapolis, is now ready to furnish headlights of this description, the current being generated by a small combined dynamo and engine, carried on the locomotive. The engine is about three horse power and has four cylinders, with the dynamo, which is about 2,000 watts capacity. It weighs about 700 pounds and is placed over the smoke arch of the locomotive between the headlight and the smoke-stack.

The trials of this apparatus made last November on the Vandalia Line showed that on very dark and rainy nights, the fences to the cattle guards could be seen three quarters of a mile away; a light-colored car would show as an obstruction on the track at about that distance, while one of dark color would not plainly be seen more than half a mile off; twelve telegraph poles would be plainly visible, while a white mile post would appear as a spot of light half a mile away. At 800 feet a tie at the side of the track would be plainly shown. Horses and cattle would

* Read at the ninth annual meeting of the Association of Railway Telegraph Superintendents, Niagara Falls, N. Y., June 19, 1890.

* See THE ELECTRICAL WORLD, June 7, 1890.

show up clearly 1,000 feet ahead, and the colors on a switch target could be seen a quarter of a mile distant.

OBSTRUCTIONS.

This shows that any serious obstruction on the track, except in case of very thick fog, could be plainly distinguished far enough ahead to stop an air-braked train traveling at a speed of 45 miles per hour, while at a reduced rate of speed during heavy storms and freshets the liability of running into open draws or into trestles or bridges carried away by high water would be greatly reduced.

Another method has been experimented with to some extent, in which groups of incandescent lamps are placed in the headlight; this has given good results, but the beam of light is not as penetrating as when the arc is used, and the carbon filaments in the lamps are soon broken on account of the vibration of the locomotive.

THE ELECTRIC LIGHT IN SWITCH STANDS.

On May 30, 1887, the Southern Pacific Railway Company, owning and operating its own electric light plant at Oakland, Cal., comprising a horizontal slide valve engine, locomotive boiler, and a 65-light 10 ampère brush arc dynamo, finding it difficult to keep the oil lamps lighted in the interlocking and automatic signals in its yards at that point, on account of the variable draughts sweeping across the bay, decided as an experiment to light twelve of these lamps from its electric light circuit, wiring the lamps in multiple.

So satisfactory were the results, that the number of signals so lighted has been increased gradually until 134 lamps in the interlocking and automatic signals, switchstands, switch lights and signal towers there are now lighted by electricity. Thirty-one of these lamps are in switches and signals that have underground wire connections, 16 of them light up four signal towers, while the balance are in signals located on posts and connected by overhead wires, all being supplied by the arc light dynamo above referred to.

The signal lamps are 38-volt, and are wired from ten to fifteen in multiple according to the number of signals within convenient distance to form a group, so reducing the E. M. F. that the lamps use only from 20 to 28 volts pressure, thus lengthening their life and yet giving sufficient amount of light to illuminate the bull's-eye lens of the lantern.

In wiring up the lamps for the purpose of preventing trouble in case they should break or are burned out, a simple switch is used with paper between the contact points, so that in case a wire leading to a number of lamps is broken, an arc will form at the switch, burn the paper, and thus close the circuit.

In putting up the lamps for the signals, the lamp with its socket is screwed on a rubber nipple placed in the centre of a wooden base, made the same size as the oil lamp bottom which it displaces, wires passing down through the rubber nipple and in grooves cut in under side of the base, connect the lamp with binding posts on the corner of the base, which makes a complete and portable device for placing in almost any style of lantern.

For the signals on posts a tin box or case was designed 7 inches by 6 inches by 3 inches with lens on one or both sides and with wooden bottom made to hinge or screw at one end and fastened by a thumb-screw at the other end, secured to the post by a pocket constructed on the narrow side of case and an iron bracket on the post in the usual manner.

This box is made from one sheet of tin and is soldered tightly together with no openings except a bottom which is closed by the wooden lamp base. If well painted, white inside and green outside, this lamp case will last indefinitely. Where the lamps are most exposed to the assaults of the hoodlums with their little guns and stones, a wire netting of one-fourth inch mesh is fitted over the lens in the form of a pocket, open at the top so the glass can be cleaned.

After being placed in position and wires connected, no further care or attention is required beyond occasionally cleaning off the outside of the lens.

The lamp complete, including case, base, lens, socket and lamp, costs about $2 each, as compared with about $5 each for the oil lamp complete, which lasted on an average of only two years.

The lamps first installed over three years ago are still in use and have required no other care or attention than renewing the underground wire to two of them.

I am informed by Mr. Slater, the Master of Signals for the Southern Pacific Company, to whom I am indebted for many of these details, that the actual expense for the installation and maintenance of these lights beyond the interest on first cost for wire, lamps and fixtures, etc., is very small, the additional amount of fuel required for the signal lamps being only about five h. p. Though in the system of accounting in use on the Southern Pacific Railway, $90.00 per month is the proportion charged to the signal lights, out of the total expense for maintenance of the whole system of arc and incandescent lights in use at that point, 30 arcs being required for depot passenger yard and road crossings, with fifty-six 16 c. p. multiple series incandescent for depot rooms and offices, and one 65 and one 50 c. p. series incandescent lamps for outside buildings. The total expense including the cost for four attendants, fuel, oil waste and supplies, repairs, etc.

The division of the expense seems hardly fair, as in the installation of the signal lamps nothing was added to the expense for attendance or repairs to dynamo, engine or boiler and very little to general supplies. All of these had to be maintained on account of the arc and incandescent lights already in use.

So well satisfied have the Southern Pacific Company become with the results from their electric light plant at Oakland that they have in consideration a larger one there to light the railroad shops, coal yards, ship and lumber yards, freight yards and ferry slips, and are operating electric plants at various other points on their line.

The details of this system have been so well worked out at Oakland that there seems but little room left for improvement, save that it might be well to have the lanterns made large enough to contain two lamps so arranged that one is automatically lighted on the extinction or destruction from any cause of the other. This feature has been adopted by the Edison company for side lights of ocean or river steamers, lighted by electricity, where it is extremely important to keep the lamp constantly burning at night.

The above mentioned plant seems to be the only one thus far installed on so large a scale, and the results obtained evidence a large economy as against the use of the oil lamp for this purpose, where a railroad company owns and operates its own electric light plant of sufficient capacity to supply the signal lamps. As an illustration, the Central Railroad of New Jersey have 45 interlocking signal lamps at their Jersey City station, which consume five gallons of No. 7 oil daily at 10 cents per gallon or $15.50 per month, with the two lamp men at $40 and $45 per month, the total expense for the 45 lamps is $100.50 per month, as against $90 for the 134 lamps of the Southern Pacific at Oakland, without considering the cost of breakage, the trouble from lamps blowing or bursting, which is likely to occur at Jersey City.

LIGHTING PASSENGER TRAINS.

In regard to the electric lighting of trains, this subject was so fully treated by Mr. Selden in his admirable paper read at the last meeting of the Association, that there is little left for me to add; however, some facts have come to my knowledge that may be of interest in this connection.

In the United States at least the system of lighting from storage batteries, charged at each end of the run, does not appear to increase in popularity. The Boston and Albany Railroad after two and a half years' trial, recently abandoned electricity on the two trains that were so lighted between New York and Boston, and substituted the Pintsch Gas System. It is stated that the principal cause of this action was the cutting down of the overhead wires in New York, preventing them from charging the storage batteries at that end of the line, as the cars were not equipped with oil lamps which could be used during that time, but it is also claimed that considerable trouble was experienced from the lamps frequently breaking and that the expense of maintenance was too great.

The Pennsylvania Company*, however, still continues to light their parlor cars from the storage batteries, using a low voltage lamp.

The Intercolonial Railway of Canada has adopted the accumulator system alone on the trains between Halifax and Quebec, and now have more than forty cars fitted up with electric lamps, which are of 16 c. p., and vary from eleven to twenty-two to a car. The accumulators are charged at four different points on the line, running about five hundred miles with the one charge; and the results thus far obtained are very satisfactory, but to provide for emergencies oil lamps have been retained in each car.

The combination of dynamo and storage battery, first adopted by the Pullman Company, is gradually being extended in this country, and is giving great satisfaction in the East and West, but, it appears, at a large expense for maintenance. The Chesapeake and Ohio vestibule train, "Fast Flying Virginian," running between New York and Cincinnati with six cars, is supplied with 118 lamps, divided up thus: two Pullman, 30 lamps each; dining car, 26; day coach, 16; combination car, 18, and the baggage car, 3. Up to May 1, 1890, the average cost, per lamp, for maintenance and renewals was $1.10 per month. Yet where the exhaust steam is utilized for heating the train, the cost can be materially decreased.

With this object in view, the Chicago, Milwaukee and St. Paul Railway have recently added to their equipment two independent light and heat tenders, which carry their own boilers for steam heating and for running a Westinghouse automatic engine, attached to a No. 4 Edison compound wound dynamo, supplying the current direct for lighting all the cars in the train, thus doing away with the dynamo on the baggage car and storage battery combination.

The results have been very favorable, and during more than six months of constant service there has not been a single failure. This company have four trains covering about 45 cars, lighted by electricity, and expects to adopt this system of illumination on all of its through trains. A full description of the tender, with drawings and other details of the electrical arrangements, will be found in THE ELECTRICAL WORLD of June 21, 1890. It is stated that the expense of building and equipping these tenders is not much greater that the cost of the storage battery-dynamo combination, with the expensive wiring required in that system.

It is confidently believed that the cost of lighting trains by electricity in the United States can be greatly reduced by adopting the method so largely used abroad, of getting power from the axle.

Mr. Houghton, the telegraph superintendent of the London, Brighton & South Coast Railway, one of the patentees of the system, advises me that there are 16 trains running on that road which are so lighted—13 of them local trains and three express; the speed of the express trains reaches 70 miles an hour, while that of the locals runs from 20 to 60 miles per hour.

The express trains are wired for an average of 70 lamps and the others 40; the candle power of these lamps varies from 8 to 16, according to the speed of the train.

The dynamo furnishing current for these lamps is placed in the baggage car, and has a pulley at each end connected by belts direct with the axles of the car. No intermediate shafting being used, the slack is taken up by loose pulleys that can be pressed upon the belts.

The dynamos on these trains have a maximum capacity of 5,000 watts, varying with the speed of the train, which at 10 miles per hour gives about 48 volts and 35 ampères, and at 60 miles, 65 volts and 75 ampères, the E. M. F. and current of the dynamo gradually increasing with the speed. The brushes are mounted in pairs on a rocking frame so arranged that either set of brushes can be brought in contact with the commutator as required by the direction of the train.

In the same car with the dynamo, 22 accumulators weighing about 4,000 pounds are placed in parallel with the dynamo for use whenever the train stops.

Connected by a belt from the dynamo is a centrifugal governor which joins up the circuit at any desired speed, causing the dynamo to charge the accumulators. When the lamps are not lighted, the governor introduces resistance into the dynamo field, reducing the output to about 40 ampères, in order not to damage the accumulator plates. When, however, it is necessary to light the lamps, the dynamo makes the full current, of which about 35 ampères pass into the lamps, the balance being stored in the accumulators.

In each lamp circuit a regulator is placed in order to keep the light in the lamps at the same power, regardless of the speed of the train, and shunt any surplus current into the accumulatiors. So that 42-volt lamps may be used with a dynamo of any E. M. F. above that voltage without any variation in the light of the lamps.

The connections between the cars are made by coupling two cables together, and when the dynamo runs below a certain speed a cut-out breaks the circuit of the armature, preventing the cells from discharging themselves through it and burning it out. Should the dynamo not furnish enough current for the lamps, the accumulators supply the balance, and in doing so strengthen the field magnets and thereby cause an increase of current in the dynamos.

* See THE ELECTRICAL WORLD, May 10, 1890.

One arrangement of the circuits of these trains has the field magnets of the dynamo wound with two wires in opposite directions, one of which is in shunt to the armature, as if the dynamo was an ordinary shunt machine; the other is wound in the reverse direction, as if the dynamo were a compound machine, and the accumulators are in series with the wire. The lamps are also in shunt with the armature.

The trains on which this system is used consist mostly of 10 cars, which run solid, that is, are not broken up, and average forty 12 c. p. lamps to a train. By using accumulators in each car, however, no difficulty would be found in splitting up the train at various points.

The figures given by Mr. Houghton show:

Total weight of the plant on each train	3 tons
Cost of plant on each train	400 lbs. sterling
Cost of maintenance per annum	65 "

The only attention given the trains is at each terminus, where one man inspects the apparatus, oils the pulley bearings, etc., before the train pulls out.

One of these trains has been running since Dec. 19, 1883, without a single failure being reported. During the first eleven months of its use it made 2,352 trips and ran 27,322 miles.

The Midland Railroad of England is running three trains lighted by electricity, and has recently fitted up two others. Two of these are short trains always run solid, and the other main line trains made up at various points. The dynamo is placed in the baggage car and is also driven from the car with about the same electrical arrangements as are used on the London & Brighton road. The short trains have 85 lamps run from one set of storage batteries in the baggage car. On one train the batteries are in series, but on the others in parallel. This seems to be the most satisfactory. Eight-candle power lamps are used on this road, two to each compartment, which can be turned down, and this feature is found to be very convenient to through passengers.

This system of illuminating passenger trains is becoming very popular in England, and it is believed that all such trains on the important roads of the Kingdom will shortly be equipped in this way. The expense as shown by seven years experience on the London & Brighton road is certainly not greater than where common oil is used, and seems to corroborate the report made by Mm. Sartiaux and Weissenbruch, to the International Railroad Congress at Paris, a year or two ago, in which it was stated, that for lights of the same candle power, gas supplied by the Pintsch system would cost about 11.3 centimes, and Colza oil about 16.9 centimes per lamp hour as against 5.6 centimes for the electric light.

Compared with the practice on American roads, the economy of this method of generating the current is remarkable. It has been stated, however, by various authorities, that it is impossible to secure even fair results in train lightning in this country where the power is supplied by the car axle, owing to the numerous curves on American roads, around which the wheels will often slide without turning the axle a single revolution, thus seriously damaging belts and armature, and the constant changes in speed, while English roads are almost always tangents, and a high and constant rate of speed is maintained. The experiments made here some years ago seem to corroborate these statements.

In 1886, or 1887, Mr. Barrett, of Springfield, Mass., fitted up a train on the Connecticut River Railroad to be lighted with electric lamps run from a dynamo obtaining its power from the car axle. A countershaft was used and a peculiar arrangement of a friction clamp transmitted the power to a pulley on the shaft. This clamp was governed by centrifugal weights balanced by stiff springs. When the dynamo ran at its normal speed these springs just balanced the friction of the clamp, and there was no slip; any increase of speed then caused the friction to diminish and the pulley slipped upon the shaft until the equilibrium was restored; 24 accumulators were connected with the circuit as a regulator, keeping the lamps lighted when the train stopped, and a centrifugal governor broke the accumulator circuit when the train slackened its speed. The brushes were attached to a rocking arm, or lever, which was tilted by magnets in their direction in accordance with the forward or backward movement of the train.

Owing to the arrangement of the car trucks, it was found very difficult to obtain the proper speed of the dynamo, and after successive trials with belts, ropes and chains, it was finally abandoned. Since that time there have been no further experiments of this character in the United States, but it is stated that such improvements are now being made in the driving gear as will obviate the difficulties heretofore encountered, and that further trials in this direction may be looked for within the next six months.

The electric lighting of trains has been hitherto considered very much as a luxury, but its superiority has been demonstrated in so many ways that it is now being regarded almost as a necessity, yet before it can be generally adopted it must be practicable to light the cars on a large scale, and to maintain the plant on each train in good order without expert assistance; it must also be so simple, and at the same time so durable, that mechanics of ordinary ability can be utilized to make the few repairs it will require; its cost, therefore, must be reasonable as compared with other methods of lighting, and the character of trains on which it is to be used.

From the facts above mentioned, it will be conceded that all of these requirements are filled by the English system of taking power from the car axle. It is, therefore, confidently expected that the well-known ingenuity of our American engineers and inventors will be found sufficient to overcome the obstacles which now prevent us from utilizing in the same way the motion of the trains on our roads.

The successful illumination of the Hoosac Tunnel in Massachusetts by 1,250 incandescent lamps, placed 40 feet apart on each of the two tracks, affords a remarkable illustration of the flexibility and superiority of the electric light over other illuminations, and the advantage of the arc and incandescent light for the illumination of our depots, waiting rooms, train sheds and offices are so apparent, and well understood, and their use so extensive, that it is unnecessary to make more than a passing notice of this branch of the subject.

In thus considering the various directions in which the electric current has been adapted for illuminating purposes in the railroad service, one is struck by the extraordinary progress that has been made in the art during a few years, and the enormous possibilities that the future opens up for the utilization of this most wonderful of nature's forces. So much has already been accomplished and so numerous are the workers in the new field, that before another de-

cade of years has rolled around, steam will have been supplanted by electricity as the motive power of our railroads and the locomotive of the future will indeed be the fiery steed called lightning harnessed and subject to the control of man.

The Electrical Section at the Edinburgh Exposition.*

The electrical section of the Edinburgh Exhibition is distinctly the most representative and interesting. This is as it should be. When the idea of commemorating the completion of the Forth Bridge by an International Exhibition was originated by Mr. A. R. Bennett, M. I. E. E., general manager in Scotland to the National Telephone Company, his desire was to illustrate the present state of electrical engineering. Unlike the proverbial rolling stone, however, the project increased in dimensions as time progressed; and in midsummer last year it was decided to widen the scope. Electrical engineering, however, was still retained as the main feature of his scheme, and Mr. Bennett is to be congratulated on the general excellence of the section; while Mr. Wm. A. Bryson, M. I. E. E., the engineer and electrician, may be complimented on the general arrangements in the Machinery Hall. The electrical machinery is to the west of the centre of the hall, and is generally driven by special engines supplied with steam from Messrs. Galloway's boilers.

Electricity as applied to the purposes of lighting is more fully represented than any other application of the power. The National Telephone Company has an exhibit showing the working of a centre, and with this centre are connected various stalls in the exhibition. The Post-office authorities have a complete exhibit, showing historical as well as modern telegraph apparatus used in British post-offices, starting with the old Cook and Wheatstone needle telegraph of 1837. The Eastern Telegraph Company, the Consolidated Telephone Construction and Maintenance Company, and other similar companies have all stands, illustrative of the transmission of sound, etc., by electricity, while the London & Northwestern Railway Company show many electrical instruments for signalling, etc.; but general electric lighting plant predominates. This is not surprising, for apart from its general utility and commercial importance, it presents greater possibilties of effective display.

The visitor to an electrical exhibition of to-day is prepared to direct his attention to exhibits of two distinct types: on the one hand to those that illustrate the strides that science has made in the exact measurement of electricity, and on the other to those belonging more particularly to the practical applications of the power and properties of electrical currents. In his search for the former the visitor has no difficulty in finding the display of the instruments by Sir William Thomson, as they are the first met with in the section of the Machinery Hall devoted to electrical exhibits. The stand is an unpretentious one, but in view of the research involved and the results obtained it is, perhaps, unequalled in the exhibition. It contains his new standard electrical instruments made by Mr. James White, Glasgow. Of these special mention should be made of the deci-ampère balance from 1 to 100 deci-ampères, the hekto-ampère balance from 6 to 600 ampères, and the composite balance. These, with other "balances" of Sir William Thomson's, the centi-ampère, deka-ampère, kilo-ampère, etc., are founded on the mutual forces, discovered by Ampère, between movable and fixed portions of an electric circuit. The mutually-influenced portions are circular in shape, and, when consisting of one or more turns of the conductor, are called ampère rings, and when of less than a whole turn the term arc is usually applied. In each one of the balance instruments, except the kilo-ampère balance, each movable ring is actuated by two fixed rings—all three approximately horizontal. There are two such groups of three rings—two movable rings attached to the two ends of a horizontal balance arm pulled, one of them up and the other down, by a pair of fixed rings in its neighborhood. The current is in opposite directions through the two movable rings to practically annul disturbance due to horizontal components of terrestrial or local magnetic forces. The new voltmeter, which is portable, and is for the measurement of potential in connection with installations on board ships, is also shown. In the admirable work describing his instruments, the great scientist himself states that the voltmeter consists of a small oblate of soft iron supported on a stretched wire in the centre of a solenoid of fine copper wire connected in series with platinoid resistances, variable according to the potential to be measured, and is founded on the principle that an oblate spheroid of soft iron, movable round a diameter, tends to turn its equatorial plane parallel to the lines of force in a uniform magnetic field. The pointer is fixed relatively to the oblate in such a manner that, when the pointer is at the zero position of the scale, the equatorial plane of the oblate is inclined about 45 degrees to the lines of the force of the solenoid. The adjustable magneto-static current meter consists essentially of a small steel magnet or system of magnets suspended in the centre of a uniform field of force due to two coils, each having one or more turns of copper ribbon or wire, and also under the directive influence of two systems of powerful steel magnets. The suspended system of magnets is attached to one end of a vertical shaft passing down centrally through an opening in the soleplate of the instrument from an indicating needle which is supported by a jewelled cap resting upon an iridium point. The two systems of directive magnets are circular in form, and each ring is composed of two semicircular magnets placed in a brass cylindrical frame with their similar poles together. Each system is securely fixed to a circular brass frame, which fits on to the cylindrical case of the instrument in such a way that the systems are capable of being turned round, together or separately. The instrument has a tangent scale, which is adjusted in its position before the instrument is sent out, so that the needle indicates equal differences of readings for equal differences of current. There is also shown an ampère gauge, of which there are different types made, ranging from ·5 to 500 ampères. These, with other instruments on the stand, will be viewed with great interest.

On a stand in the north court of the main building Professor James Blyth, of the Glasgow and West of Scotland Technical College, also exhibits several ingenious appliances for electric measurements. These include, among others, a current weigher, which gives the results in absolute measurement. In his current and voltmeters he reaches his result by determining the strain of a spring produced by the attraction of a current in a solenoid acting on a thin soft iron armature. An interesting instrument is his volt and current thermometer, in which a current is used to produce a change of temperature in a long thread of mercury in a glass tube, and from the expansion of which the measurements are determined. All his exhibits, it may be said, indicate the type of work that the student of electricity in the Glasgow Technical College may be expected to face, and demonstrate the good fortune of the directors in having the services of a man capable of devising such instruments. Messrs. Clark, Latimer, Muirhead & Co., London, are well represented by ammeters, voltmeters, galvanometers, proportional coils, resistance boxes and the standard cells. They have also on the roof of the Machinery Hall a search-light projector of 20,000 c. p., which is worked from one of their Westminster dynamos.

One of the largest and most complete demonstrations of what electricity can do for lighting, for locomotion and for general mechanical driving purposes, is that of the Electric Construction Corporation, Limited. Above their stand is erected a boarding, fully two feet deep, carrying about 800 16 c. p. incandescent lights, forming the letters composing the name of the company, and the effect of the illumination is striking. The electricity for these lamps is supplied by an Elwell-Parker alternating current dynamo, driven by a Willans engine, as used by the Metropolitan Electric Supply Company. In this machine the armature is stationary, contains a laminated iron core of large section, and permits of good facilities for perfect insulation. The rotating portion of the machine consists of a number of soft wrought-iron poles, bolted upon a cast-iron centre fixed on the shaft. The aramature is covered with wood so as to protect the attendant. The dynamo runs at about 400 revolutions, with an output of 100 kilowatts. There are also two Elwell-Parker continuous dynamos driven by horizontal high-pressure engines. Part of the electricity generated by these is for driving sewing machines on Messrs. Singer's stand, and other motor purposes, and part for storage. The system of storage and distribution exemplified on the stand is that adopted by the Chelsea Electricity Supply Company.

Among the other exhibits of the application of electricity here, we may notice the electric tramcar, as in use in Birmingham.

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited, of the well-known Silvertown Works, although represented only by one exhibit, must take a prominent position, as the machine has many merits. The chief characteristic is the compactness, the engine and dynamo being bolted on one bedplate of cast iron, occupying together about 10 ft. The driving engine is the "Globe" compound direct-acting type, made by Messrs. Musgrave & Sons, Bolton. The cylinders are 8¼ in. and 15 in. in diameter, and the stroke 8 in. There is a single balanced valve between the cylinders. The whole engine is inclosed in sheet-iron casing, and the well in which the crank works is partly filled with lubricating oil. The engine works under a pressure of 100 lbs., and up to 375 revolutions per minute, the piston speed being 500 ft. The dynamo develops 350 ampères, the electromotive force being 105 volts. The field magnets, which weigh 3 tons 8 cwt., are of Lowmoor iron, and the armature weighs 21 cwt.

An adjoining exhibit offers a contrast to such dynamos as that just described. It bears the date February 22, 1844, and is one of the earliest magneto-electric machines constructed on the principle of Faraday's discovery. The maker was Mr. J. S. Woolrich. Bobbins wound with copper wire are fixed on the rim of a wheel and caused to pass by the rotation of the wheel through the jaws of four sets of permanent steel magnets placed symmetrically. The wires from the separate bobbins run to the nave of the wheel, where the currents are collected in the usual way. The presence of this primitive yet wonderfully perfect instrument links up the magnificent mechanical results of electrical engineering with Faraday's far-reaching discovery of the seemingly insignificant fact that if a wire loop be moved to cut the lines of force in a magnetic field a current will flow in that loop.

The firm of Ernest Scott & Co., Newcastle-on-Tyne, have a good exhibit of electric lighting plant for ordinary and ship use. The machines are of the alternating type giving a very high voltage and are associated with transformers, of which some examples are shown. One machine driven by a Robey vertical engine, 8¼-inch cylinder by 8-inch stroke, develops 10 ampères at 1,000 volts, the armature making 1,200 revolutions. A type of plant for ship installations is shown. It consists of a 6½-inch by 6-inch vertical high-speed engine, coupled direct to a dynamo with a Gramme ring armature, making 325 revolutions per minute, giving 65 volts, 70 ampères, sufficient to maintain 100 incandescent lights. One or two of their machines are used for lighting stands.

The conversion of the energy of electricity into mechanical work is illustrated at the stand of Messrs. Immisch & Co., well known in connection with the construction of electric motors for propelling the Thames electric launches. They exhibit motors similar to those in these launches. On their stands is also shown a tramcar motor, working to 1,000 revolutions, and developing 10 brake h. p. It is of a type used by the North Metropolitan Tramway Company at Barking. These motors occupy little space, and are of great service for many purposes, such as in mining operations, whether for haulage, or for driving drills, or coal-cutting machines. The relative work done to the weight of the motor is about 1 h. p. per hundredweight. A motor may be seen driving an Ingersoll percussion rock drill, the current being supplied from one of Messrs. King, Brown & Co.'s dynamos.

Excellent exhibits in dynamos and plant generally are shown by Messrs. Prentice, Napier & Co., Suffolk; Norman & Sons, Limited, Glasgow; Woodside Electric Company, Glasgow: Hartnell Wilson, Leeds; King, Brown & Co., Edinburgh; Kennedy, Rankin & Co., Kilmarnock; the Brush Company, and others. Sir William Vavassour shows primary batteries chiefly for electric lighting, and the Lord Justice, Clerk of the Court of Session, better known as Mr. J. H. A. MacDonald, is also an exhibitor. There are three electric welding machines from Mr. Richard Miller, Glasgow.

However much the ordinary visitor may be impressed with the importance of electricity for practical uses by the magnificent demonstration of the methods of producing, distributing, and using this power, yet the enormous strides which have been and are being made will be more vividly enforced by the brilliant array on several stands of artistic fittings which manufacturers find it to their advantage to provide for the progressive wants of the times.

* From *Engineering*.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, July 7, 1890.

The Cobb Vulcanized Wire Company, of Wilmington, Del., has received an order for 110,000 feet of Cobb cable, to be used in the city of Philadelphia.

Lawrence, L. I.—A time plant has been installed in the residence of Geo. C. Rand, of New York city, by the Standard Electric Time Company, of New Haven, Conn.

To Change From Steam to Electricity.—The Coney Island and Brooklyn Railroad Company has applied to the State Railroad Commissioners of New York for permission to change its motive power from steam to electricity.

A New Brush Plant.—Mr. C. W. Phipps, of the New York office of the Brush Electric Company, reports the installation of a new Brush alternator of 600 lights capacity at Redbank, N. J., for public and private lighting, and of a new isolated plant for Mann Bros., on Grand street, in this city.

Schenectady, N. Y.—The Westinghouse Illuminating Company has been making considerable improvement in its central station plant of alternate current electric lighting. A new arc light machine of the Westinghouse alternate current system has lately been added to the capacity of the plant.

Hearing Before the State Railroad Commissioners.—The Buffalo Street Railroad Company's application for a change of motive power from horses to electricity has been considered by the State Railroad Commissioners during the past week. No decision has yet been given, owing to the uncertainty concerning the wishes of the property owners along the proposed route on Niagara street.

The Edison Manufacturing Company is getting out a very fine descriptive catalogue of the Edison-Lalande primary battery. Aside from its value as a battery catalogue this pamphlet will be of interest as showing the possibilities of combining artistic typographical effects with matters of purely commercial importance. It will be profusely illustrated and tastefully arranged. Copies may be secured from James F. Kelly, of the Edison Machine Works, 19 Dey Street, New York city.

Lighting of Mr. Flagler's Yacht "Alicia."—This new steel yacht arrived in New York last week from the yards of her builders at Wilmington, Del. She is 180 feet in length over all and carries triple expansion, surface condensing engines of 1,100 h. p. No expense has been spared to make the vessel safe, luxurious and comfortable, and to attain this end she has been lighted throughout by electricity. The fixtures are elegant examples of the designer's art, and by the use of tinted glass, beautifully decorated, some very fine effects are produced.

Consolidation in Newark, N. J.—The Electric Light and Power Company, one of the first in the business in this country, has bought out the Thomson-Houston plant and absorbed its business. It has a capital of about $2,000,000. The officers are: President John D. Harrison of Newark, vice-president Marcellus Hartley of New York city, secretary Samuel S. Dennis, and treasurer and manager Philip N. Jackson of Newark. It was originally the Weston Electric Lighting Company, and worked under Mr. Edward Weston's patents, with arc lights only. Two years ago it absorbed the Schuyler Electric Lighting Company's local plant.

An Interesting Pamphlet has been issued by the Interior Conduit and Insulation Company giving testimonials as to the value of its system of interior tubing. The first page contains a fac simile of Mr. E. H. Johnson's letter to Mr. Edison and the brief reply. Mr. Johnson wrote: "Were you to rewire your house to-day, what system of wiring would you employ?" Mr. Edison replied, "The asphaltic paper tubes of the Interior Conduit Company." On the next page is a facsimile of a letter of recommendation for the system from Prof. Elihu Thomson. Other testimonials are given, together with extracts from the rules of the Boston, New York and Philadelphia Fire Underwriters' rules upon the requirements for interior and concealed wiring. W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
No. 146 Franklin, corner Congress St.
Boston, July 5, 1890.

The Thomson-Houston Electric Company has lately shipped a large consignment of electric hoisting machinery to Castle Gate, Utah.

The County Commissioners of Massachusetts have been asked to make a survey for a proposed line of electric railway from Lowell to Tyng's Island.

New Officers.—Henry C. Buck has been chosen president and Joseph B. McDonald one of the vice-presidents of the electric light company in Woburn, Mass.

Mr. C. E. Bibber, traveling salesman for the Holtzer-Cabot Electric Company, will take a short vacation, and intends to visit the Provinces before his return.

A New Insulating Substance made from slate is soon to be put upon the market. It can be molded into any shape and is claimed to be superior to porcelain.

A Police Signal System Extended.—An order for a loan of $10,000 for extending the police signal system was passed by the Lowell (Mass.) city government last week.

Work on the New Electric Road in Milford, Mass., will be begun within a month. It is not yet decided whether the overhead or accumulator system will be used.

The Middleboro (Mass.) Electric Light and Power Company is to buy out the Middleboro Gas and Electric Company, a basis of trade having been substantially agreed upon.

Railway Franchise for Disposal.—The holders of the franchise for the Holbrook (Mass.) street railway are willing to surrender the same to any trustworthy persons who mean business.

The Lynn & Boston Railroad is planning for an electric line to encircle the entire city of Lynn. The poles and wires have been purchased and a new power station will be built large enough to accommodate 2,000 horse power.

Gov. Brackett's Veto.—The Governor of Massachusetts has vetoed the bill authorizing the consolidation of the gas and electric light companies, and the Senate has refused to pass the bill over the Governor's veto—3 yeas, 34 nays.

The New Chimney of the Narragansett Electric Light Company at Providence, R. I., is rapidly nearing completion, over 110 feet of the 250 being already erected. This company has now about 600 Thomson-Houston arcs in use and is constantly adding more. New foundations are being laid under the direction of Messrs. Remington and Haenthorn, the designers, and it is pro-

posed to have this the most complete station in New England when finished.

Plans for a Proposed Line of Electric Railway between Attleboro, Mass., and the Rhode Island line are well under way. The proposed line will run from Attleboro to Dodgeville, thence to Hebronville and Lebanon to the State line, and will ultimately be extended to Pawtucket, R. I.

The Selectmen of Peabody, Mass., voted to lay on the table the petition of the Naumkeag road for an extension of time in locating poles and wires. The petition of the same road for a location for tracks was also laid on the table. The selectmen desire that the Essex Electric and Naumkeag roads should come to a better understanding concerning locations where the roads cross each other before any further petitions are granted.

Electric Light Contract.—Several futile attempts have been made to settle the difficulty that exists between the selectmen of Stoneham, Mass., and the Woburn Electric Company, by President Buck and J. B. McDonald. Since the contract expired with the electric company the town has been in darkness, and although Mr. Buck has several times offered to leave the matter to arbitrators, the selectmen would not agree to it, and there the matter rests. The People's Company of Wakefield is now trying to get the contract.

Mayor French, of Gloucester, Mass., has notified the Gloucester Street Railway Company that the way committee intends to ask the board of aldermen to apply to the courts for an injunction to restrain the company from erecting and maintaining poles said to be set in violation of the city permit. The company has also been notified to file a bond of $10,000 as a guarantee that the poles shall be erected according to terms by which the permission to do so was granted. The Gloucester Electric Company has also been requested to file a bond of $7,000 for the same purpose.

Vacation Notes.—Professor Thomson, Superintendent Rice and Electrician Rohrer will leave Lynn for a few days' tramp among the mountains, their objective point being Mt. Lafayette. They will go prepared to camp out, and the schedule for each man's knapsack includes a woolen blanket, a rubber blanket, hatchet, one pound of tea, one box of sardines, half-dozen lemons, half pound of crackers, some matches, cigars or cigarettes, a tin cup and a spoon. Several men from the Boston office will accompany them, following an annual custom. Mr. C. J. Van Depoele, electrician of the railway department, has just returned from a three weeks' trip to Chicago and Washington. L. H. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, July 5, 1890.

Mr. Frank Stewart, president of the Emery Electric Mining Machine Company, Chicago, has moved his offices from the Rialto to the ground floor of the Pullman building.

Insulators Burned—A recent fire at Hemingway's Glass Works, Covington, Ky., destroyed 20 annealing furnaces, all of which were filled with glass insulators for a Chicago electric firm.

Mr. G. A. E. Kohler, manager of the Chicago office of the Eddy Electric Manufacturing Company, has placed a two h. p. and a four h. p. Eddy motor in the First National bank building, Chicago.

Mr. J. M. Duncan, the Rice Engine hustler of Chicago, sold six Rice engines and two pumps to the Mutual Fuel Gas Company, of St. Joseph, Mo., this week, and a 125-h. p. Rice engine for the Silberhorn packing house in the Union Stock Yards, Chicago.

The City of Beloit, Wis., is now lighted electrically by a private corporation, the contract for the furnishing of the lights being about to expire, and the street lighting committee is in the field for new estimates for furnishing lights. There is an opening for some enterprising electric light company.

Mr. Arthur S. Huey, Minneapolis, Minn., has secured the contract for furnishing Edison apparatus to the Minnesota Insane Asylum, and also to the Grand Cañon Hotel, in the Yellowstone Park. In the latter case the dynamos will be located over half a mile from the hotel and driven by water power.

Mr. A. M. P. Cowley, the assistant cashier of the Second National Bank, St. Paul, Minn., has recently personally wired his summer residence at White Bear Lake, and now enjoys all the benefits to be derived from the use of incandescent lights, electric motor fans, electric bells, etc. The dynamo and motors were built entirely by Mr. Cowley during odd hours of leisure.

Mr. J. L. Barclay has moved the headquarters of the Chicago office of the railway department of the Westinghouse Electric Company from the Rialto to the ground floor of the Pullman building, Adams street front, where commodious offices are now being handsomely fitted up in keeping with so substantial an organization. The Westinghouse Company is at work installing several roads, and Mr. Barclay received the contracts on Tuesday for equipping two additional roads.

Electrician of the Columbian Exposition.—A very strong movement has been started in Chicago to secure if possible the appointment of Mr. J. P. Barrett, electrician of the city of Chicago, by the board of directors of the World's Columbian Exposition, to have practical charge and control of the electrical department of the Columbian Exposition. A petition requesting the appointment of Mr. Barrett has been signed by nearly all of the representative electrical men and firms in Chicago and throughout the West.

Telephone Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$298@$300	Cumberland	$ 59@ $60
Central Union	69@ 70	Wisconsin	116@ 117
Michigan	98@ 99	Bell of Missouri	140@ 145
Great Southern	30@ 32	Iowa Union	21@ 23
Colorado	38@ 40	Missouri and Kansas	54@ 55
Rocky Mountain Bell	40@ 45		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$104@$105	Chicago Edison Co	$125@$130

Henry Villard has purchased a controlling interest in the Badger Electric Light Company, the Edison Light Company, and the Cream City and Milwaukee Street Car companies at Milwaukee, Wis. Milwaukee capitalists will still retain an interest in each of the corporations. The Badger Electric Light plant was sold by John A. Hinsey, S. S. Badger, E. C. Wall, and Winfield Smith. The purchasers outside of the Villard syndicate are the same Milwaukeeans who are interested in the Edison electric light plant now being built. The Villard syndicate for the present at least will have a monopoly of electric lighting in Milwaukee, the Badger Company to continue to furnish the arc light and the new Edison plant the incandescent. By securing a controlling interest in both the Cream City and Milwaukee street car lines the Villard syndicate will have two of the best paying companies in the city. Both lines will be transformed into an electric system. F. DE L.

SOUTHERN NOTES.

NORFOLK, VA., July 2, 1890.

Will Change from Horses to Electric Power.—The cars of the new Marshall Street Line at Richmond, Va., will be running before the first of September. It is understood that at first the company will run horse cars, but that later on they will adopt electricity as a motive power.

Electric Railway Progress at Richmond, Va.—Under a suspension of the rules the board of aldermen recently agreed to extend the time from July 1 to Aug. 1 in which the Richmond City Railway Company may operate cars by electricity on its Main street route. One of the conditions required was that the company on or before June 30 deposit with the treasurer of Richmond a certified check for $1,000, which is to become the property of the city if the company fails to have 12 cars operated by electricity on the Main street route after Aug. 1, or if it fails to give a five-minute service by Sept. 11. If the 12 cars are in operation on Aug. 1, and if a five-minute schedule is rendered by Sept. 11 the company can withdraw the check.

The Three Stages of Lighting.—The Moravian town of Salem, N. C., is over a century old. Its next door neighbor—a single street dividing the two towns—is Winston which is modern and progressive. It has had electric lights some time, and is about completing an electric street railway. Thus stimulated old Salem is putting in electric lights and will also participate in the benefits to be derived from the street railway. A few days ago a workman, while fitting electric light wires in the attic of one of the antiquated buildings of Salem, came upon a number of souvenirs showing the different stages of progress through which the inmates of the household had passed. He found first a set of old-fashioned tin candle moulds, next an oil lamp of antique pattern, and lastly, a small section of a gas pipe, while he was supplanting all of these by wires for electric light.

Active Telephonic Expansion at Atlanta, Ga.—The manager of the Southern Bell Telephone Company, at Atlanta, Ga., is building telephone lines in every direction from that city. Only a few days ago a 40 mile line to Newman, Ga., was opened for business, and which is soon to be extended to Palmetto. Other "hello" towns in the vicinity of Atlanta are Chattahoochee, Marietta, Decatur, East Point, and Fairburn, all of which are now connected by wire with the Atlanta telephone exchange. The Decatur line is being extended to Stone Mountain. The Newman line just completed is the longest telephone line in Georgia. It is probable that the next telephone line will extend to Macon. At one time several years ago there is said to have been considerable talk of a line from Atlanta to Macon, but the project never materialized. If the present management of the Atlanta office of the Southern Bell Telephone Company takes the matter in hand, it will not be long before it will be a tangible reality. The central office is commended by Atlanta people for the efficiency of its service, particularly that of the night force. Y. N. B.

ENGLISH NOTES.

(From our own correspondent.)

LONDON, June 25, 1890.

The Government and the Telephone Companies.—The Postmaster-General announced in the House of Commons last week that the government does not propose to give the necessary notice of its intention to purchase the telephonic system of this country at the end of the present year. The telephone companies have, therefore, another period of seven years within which to make profit, and, it is to be hoped, improve not so much their inter-urban system as their urban systems, especially that of the metropolis.

The Abuse of Patents.—The action of the Lane-Fox Electrical Company, together with the threats of the enforcement of the Edison "feeder" patent and rumors of the furbishing up of the brothers Hopkinson's induction coil patent No. 14,233 of 1884, has aroused a feeling of considerable irritation in the industry and the chief firms whose operations come under one or the other of these patents are now taking action, with a view of uniting in self-defense. It is to be hoped that this timely action will prevent the industry from being hampered once more with costly litigation.

The Central London Railway Bill.—The bill for running an underground electrical railway from the suburb of Bayswater into the heart of the city has just reached the House of Lords, where it evoked the opposition of no other person than the Bishop of London, who moved the rejection of the bill on the ground that it would prove disastrous to St. Paul's Cathedral. If any injury happened to that great fabric, said he, could there be any greater disgrace come to the parliament of this country than that of having consented to bring ruin on one of the glories of the metropolis of England, in order that people might save 15 minutes in coming from Bayswater to Cheapside. The opposition was, however, appeased by the promise that there should be a special report from a committee as the possibility of danger to St. Paul's.

A Fire Due to Electric Light Wires.—A fire due to the electric light wires occurred last week in a large West End mansion, inhabited by R. D. Sassoon, with the result that several hundred pounds worth of damage was done and considerable alarm caused. The actual origin of the fire, as is usual, is somewhat obscure, but a reliable informant tells me that at the time of the conflagration "electric sparks were seen all over the house," which points to the presence in the house mains of a high potential current. Mr. Sassoon's house was on the circuit of the Cadogan Electric Light Company, which arranges its batteries on the consumers' premises, and charge them every day in series. As I understand that the discharging batteries are not always disconnected from the charging circuit, it follows that an earth on the house circuit, coupled with another on the charging main, would probably give rise to untoward consequences. Investigation has shown that there was, owing to the action of the new plaster upon the wire casings, a general leak throughout the house, but so far tests have failed to discover an earth on the charging main. Whatever the actual cause may have been, we only want a few such mishaps in large West End mansions to completely destroy the confidence in the electric light which the good work of the past few years has tended in a large degree to restore.

Water Power for Electric Lighting Purposes.—Although the water power in this country available for electric lighting purposes is not very great, still there is sufficient, especially in Scotland, Ireland and the North of England, to make it worth while for our engineers to turn their attention to its utilization. As an instance of what may be done in this direction, I may now mention the little Cumberland town of Keswick, which is supplied with current on the alternating system by means of a dynamo situated three-fourths of a mile away from the town and driven by Victor turbines. Lord Armstrong, than whom there is no greater authority on hydraulic matters, has lately had three turbines installed at his mansion at Cragside. The first is a turbine having a fall of 385 feet and with an output of 27 h. p. at 1,300 revolutions. It is utilized for driving two dynamos. One of these supplies lights in a building one-fourth mile distant, and the other charges accumulators. The turbine is started, stopped and regulated electro-magnetically from the house itself, which is a quarter of a mile distant. The second plant transmits power to a distance of about half a mile, the electric motor which receives the current being employed to drive a large circular saw and some lathes. The third plant, which is actuated by a 30 h. p. turbine, with a fall of 190 feet, is used for ploughing and other farm purposes, such as raising weights for ensilage. The turbines used are of the type devised by Prof. James Thompson, in which the water is taken in at the circumference and discharged at the centre, the speed being controlled by the angle of the guide blades. I may mention that turbines of this description are being used in the electric lighting of Alnwick Castle, belonging to the Duke of Northumberland. These instances show that some attention is being devoted in this country to water power for electric lighting purposes.

News of the Week.

THE TELEGRAPH.

Another Addition to the Western Union Lines.—Arrangements have been made by the Western Union Telegraph Company to secure control of the lines now operated by the Ohio Valley Railroad Company.

Decision in Favor of the Western Union.—In a suit brought by Mrs. Hannah Joseph, to obtain $25,000 in return for her alleged mental sufferings because of the failure of the Western Union Telegraph Company to promptly deliver a message to her husband to which she wanted an immediate reply, the jury gave Mrs. Joseph a verdict of 25 cents, the price of the telegram.

Telegraphers Who Would not Cheer the Queen.—The staff of the Central Telegraph Office of London, Eng., numbering 400 persons, refused to cheer for the Queen last week on the invitation of the officials, in honor of the Postal Jubilee. Instead of cheering, they groaned for the Queen, and also for Postmaster-General Raikes as a protest against his treatment of their demands for the amelioration of their condition.

The Telegraph Linemen of Spokane Falls, Wash., ceased work on Wednesday, the 25th ult., the cause being a general strike for higher wages or less hours, and at present there are no linemen working in the city. The trouble arose over the amount to pay and the time to pay. The electric light company has been paying $2.75 a day for ten hours' work, and paying once a month. On June 17th the linemen held a meeting, the result of which was the forwarding of a communication to the companies asking that they be allowed $3 a day for ten hours' work, or $2.75 a day for nine hours' work. They also asked for two pay-days a month in place of one, and that the 1st and 15th respectively be designated as such pay-days. The companies have combined in a reply to the communication of the linemen to the effect that they would not agree to the terms stated in the request, but would pay the old rate of wages, $2.75 for ten hours. They agreed, however, to two pay-days per month, and designated the 5th and 20th of each month as such pay-days. The men would not agree to these terms, and have refused to return to work.

THE TELEPHONE.

The Tropical American Telephone Company, Limited, will hold its annual meeting at Long Branch, N. J., July 30. The question of resuming the payment of dividends will be considered, as well as other important matters.

The Spokane Falls Telephone Company is doing a large amount of new work this summer. It has purchased the plant and lines of the Rocky Mountain Company, which gives it control of all the telephone lines east of Montana, Idaho, Washington and Oregon. The company is also building a long distance line from Spokane Falls to Missoula, Montana, over 300 miles, to connect with Helena, Montana.

American Manufacturers and Inventors of telephone apparatus will be interested to know that they are particularly invited to make known all their inventions and improvements to the "Red Telefonica de la Habana," O'Reilly No. 5, Habana, Cuba, the Telephone Company of Havana, which proposes to keep in the van of telephonic progress by adopting from time to time the latest and best inventions applicable to this branch of the industry.

The Inland Telephone and Telegraph Company has just been organized at Spokane Falls, Wash., with a capital of $300,000. The officers of the company are W. S. Norman, president; Chas. B. Hopkins, general manager; A. B. Irwin, superintendent, and Chas. Sidney Smith, secretary. This company has absorbed the Charles B. Hopkins system at Colfax, and does business in Eastern Washington, Eastern Oregon and Northern Idaho, and is now busy extending its lines in all directions.

The National Telephone Exchange Association will hold its next annual meeting at the Russell House, Detroit, Mich., commencing on Tuesday, Sept. 9th, 1890. Either two or three days will be required to transact the necessary business. The Russell House is conducted on the American plan and the rates are from $3.00 to $4.50 per day. Rooms may be engaged in advance by applying either to W. A. Jackson or to F. A. Forbes of the Telephone and Telegraph Construction Company, Detroit. These two gentlemen are acting as a committee on quarters. Members of the Association are earnestly requested to send any papers to be read at this meeting to the secretary, Mr. C. H. Barney, 510 W. 23d street, New York city, by the 1st of August, if possible.

THE ELECTRIC LIGHT.

Union S. C.—The citizens talk of erecting another electric light plant.

Trenton, Tenn.—A new electric light plant will probably be erected.

Roanoke, Va.—The Virginia Brewing Campany has put in an electric light plant.

Henrietta, Tex.—An electric light plant will be added to the cotton ginnery of William Lay.

New Orleans, La.—The United States Marine Hospital proposes to erect an electric light plant.

Snow Hill, Md.—Two new dynamos have been installed by the Snow Hill Electric Light Company.

Charlotte, N. C.—A new arc dynamo is to be added to the plant of the Charlotte Electric Light Company.

Selma, Ala.—The Matthews Cotton Mills Company expects to put in its electric light plant this summer.

Charleston, S. C.—The Congaree Gas and Electric Company has declared a semi-annual dividend of three per cent.

Kensington, Ga.—It is reported that the Kensington Land, Coal and Iron Company will erect an electric light plant.

Quitman, Ga.—Messrs. E. P. Denman and Clayton Grover have received a franchise to erect an electric light plant.

Chattanooga, Tenn.—It is reported that Lieut. Steele, U. S. A., is looking about the city with a view to selecting a site for an electric plant.

Baltimore, Md.—A Thomson-Houston electric light plant with a capacity of 1,500 lights has been ordered by the Maryland Electric Company.

Chattanooga, Tenn.—The arc light on the tower of the "Lookout Inn" is about 2,000 feet high, and can readily be seen in clear weather from portions of five different States.

Carrolton, Mo.—The Westinghouse Electric Company is installing alternate current apparatus for a central station plant for electric lighting which will have a capacity of 500 lights.

Tonawanda, N. Y., is one of the latest towns in New York State in which the Westinghouse alternating apparatus has been introduced. The plant has a capacity of 500 incandescent lamps.

Crewe, Va.—The Crewe Land and Improvement Company has been incorporated, with J. H. Dingee, president, and M. W. Bryan, of Roanoke, secretary, and is authorized to erect an electric light plant.

Washington, D. C.—The Glen Echo Casino will be lighted by the Thomson-Houston incandescent system and the Ball arc system. The wiring is being done by Messrs. Royce & Marean, of Washington.

Ilion, N. Y.—Mr. A. G. Greenberg, of the Ft. Wayne Electric Company, has just closed a contract with the Ilion and Mohawk Gas Light Company for a 60-light 2,000 c. p. plant complete of the new Wood arc system.

Waycross, Ga.—The Satilla Manufacturing Company has been incorporated to manufacture ice and operate an electric light plant, gas works, etc. The incorporators are M. Albertson, J. S Bailey; L. Johnson and others.

Primary Battery Lighting.—At Baltimore, Md, Edwin Sutherland, of Washington, D. C., T. E. Hambleton, W. H. Bayless and others have incorporated the Volta Electric Battery Company with a capital stock of $300,000 to manufacture a primary battery for electric lighting and power.

A New Plant in Michigan.—The beautiful little town with the romantic name of Crystal Falls, Mich., is about ready for a large sized boom. The first visible sign of its march to progress is the establishment of a central station plant for electric lighting, for which the Westinghouse Electric Company has received the contract to furnish alternating current apparatus of a capacity of 750 lights.

The Westinghouse Company, through Mr. Baines, its New England representative, reports the installation of one 750 and one 500 light alternating incandescent dynamo for the Laconia Electric Light Company, Laconia, N. H.; one 500 light alternator, for the Edison Illuminating Company, of Newport, R. I., and one 300-light direct incandescent isolated, for Roy's woolen mill at North Bellingham, Mass.

Baltimore, Md.—The Brush Electric Light Company has again been awarded the contract for lighting the city, and is now obliged to increase the capacity of its central station apparatus. A contract for alternating current machinery for 3,000 lights was made with the Westinghouse Electric Company a few days ago. This makes the Baltimore plant one of the largest alternating current central stations in the country.

Electric Light Machinery as a Fixture.—Machinery placed in a building for the purpose of supplying it with electric light, without any intention to annex it to the realty, does not pass to a purchaser of the realty at foreclosure sale. The intention with which such machinery was placed in the building is one of fact, on which the verdict of the jury is conclusive upon appeal. Decision of this question given in the case of Vail vs. Weaver, Supreme Court of Pennsylvania.

Spokane Falls, Wash.—Two forces of workmen (day and night) are laboring steadily on the new power station of the Edison Electric Illuminating Company in the hope of having it ready for occupancy in the fall. It is expected to be one of Spokane's handsomest structures, and is estimated to cost in the neighborhood of $100,000. The company has about finished its contract for erecting lamps with which to illuminate the city. It now has over 500 arc lights burning nightly, and the majority of the dwelling houses are using the incandescent light.

Electric Light Progress in the South.—According to the Baltimore *Manufacturers' Record*, the number of electric light companies organized during the first half of each of the last five years, 1886 to 1890 inclusive, was respectively, beginning with 1886, 17, 33, 80, 134 and 127, while for the corresponding periods the number of gas companies organized was 15, 24, 18, 12 and 16. During the last three months four electrical enterprises have been projected in Alabama, three in Arkansas, three in Florida, seven in Georgia, nine in Kentucky, three in Maryland, one in Mississippi, two in North Carolina, three in South Carolina, five in Tennessee, nine in Texas, five in Virginia and two in West Virginia.

Removal of Electric Light Wires.—Certain parties agreed with an electric light company to use its light for a year, and to give it the right of free access to repair and remove lamps and wires. The wires were fastened to the studding, and then plastered and papered over. At the end of the year the parties receiving the light terminated the contract, but refused to allow the company to remove the wires imbedded in the plastering, claiming that they had become a part of the realty. Whether they did so become was a question of intention of the parties, to be decided by the jury, and having been decided in favor of the company, will not be reversed upon appeal. This decision was rendered in the case of the Harrisburgh Electric Light Company vs. Goodman, Supreme Court of Pennsylvania.

The Huntington Search-Light, says the Providence *Journal*, is now in working order upon the steamer "Connecticut" of the Providence & Stonington Line. The search-light is situated on top of the pilot-house, and is played on any quarter desired by the pilot within. In the pilot-house there are four switches controlling the current that runs to the search-light and fog-horn, and by means of these switches the pilot can start the search-light so that it will flash at regular intervals automatically; or it may be made to burn steadily; or it may be made to flash automatically at the instant the fog-horn begins to bellow, and cease to flash when the bellow ceases; or the horn may automatically bellow alternately with the flashing of the light; or the flashing and bellowing may be done alternately or simultaneously by hand.

The Westinghouse Electric Company reports the following orders received during the month of June for alternate current central station apparatus: Moundsville, Va., 500 lights; Valdosta, Ga., 500; Newark, N. J., increase, 1,500; Cleburne, Tex., 500; Newport, R. I, increase, 500; Hamilton, O., 500; Tacoma, Wash, increase, 1,500; Vinton, Iowa, 500; Hiawatha, Kan., 500; Saginaw, Mich., 750; Tonawanda, N. Y., 500; Philadelphia, Pa., 750; Crystal Falls, Mich., 750; Oconto, Wis., increase, 750; Ogden, Utah, 1,500; Baltimore, Md., increase, 3,000. Arc lighting apparatus, of the new Westinghouse arc light system, was sold during the same month for central station purposes in the following towns: Valdosta, Ga., 40; Ogden, Utah, 80; Schenectady, N. Y., 60; Rockville, Ind. During the month a large arc light plant was also ordered for the Zoological gardens at Cincinnati.

APPLICATIONS OF POWER.

Small Motors for fans and other light work are in great demand at Memphis, Tenn.

Beaumont, Tex.—An electric street railway is projected by the Beaumont Improvement Company.

Rockville, Md.—The Chevy Chase Land Company has been granted the privilege of constructing an electric railroad.

Mt. Airy, N. C.—An electric railway to White Silver Springs is projected by George W. Sparger and others. The length of the route is four miles.

Aberdeen, Wash.—The Aberdeen & Hoquiam Electric Railway Company has commenced the construction of an electric street railway in Aberdeen, which will be extended to Hoquiam, four miles distant.

Chicago, Ill.—The South Chicago City Railroad has been purchased by Douglas S. Taylor and others for $100,000. The horses may be superseded by electric motors in the near future. The road is seven miles long.

An Electric Railway is to be one of the attractions of the Jamaica International Exhibition at Kingston, West Indies. Bids for its construction are wanted by Thomas Amor, Stewart Building, 280 Broadway, New York city.

The Pullman Electric Motor Company has been incorporated at Chicago, Ill., with a capital stock of $200,000, to manufacture sewing machines and electric motors. The incorporators are E. N. Talbot, H. B. Seymour, and L. H. Bisbee.

A New Electric Railway put in Operation.—The Oakland and Linden electric line, which is a feeder of the Fifth avenue cable line, in Pittsburgh, Pa., has just been successfully started. The people are pleased, and the management looks forward to a comfortable revenue.

An Electric Railway Equipment Wanted.—The Belt Railway Company, of Owensboro, Ky., has just been organized, and proposes to build from five to ten miles of street railway and operate the same by electric power. Mr. Asa Williams, the superintendent, can give information.

Memphis, Tenn.—The construction of the new electric road progresses but slowly, owing to the city's delay in paving some of the streets the tracks are to occupy. It is expected that cars will be running by Aug 1. The poles for the overhead line are nearly all in position, and five motor cars are ready for operation as soon as the road is completed.

Fitchburg, Mass.—The aldermen gave a hearing recently on the question of allowing electricity to be used as a motive power on the street railway. The Street Railway Company was given permission some time ago to extend its tracks to the Leominster line, and it now asks permission to use electric motive power on any or all of its system.

Tacoma, Wash.—The Tacoma & Steilacoom Railway Company has been incorporated by Messrs. T. O. Abbott and G. W. Thompson. Eleven miles of rails have been ordered, and the delivery of the first rails will be made in July. Negotiations are now under way for the extension of the Tacoma Railway and Motor Company's electric line five or six miles.

St. Louis, Mo.—The Cable and Western road was sold recently for $150,000 to Maj. B. D. Lee, who bought it in for the bondholders. Lee, Higginson & Co., the purchasers and principal creditors of the road, were instrumental in organizing the Central and Western Company, which recently secured a franchise to run an electric line parallel to the old Cable and Western.

A Possible New Storage Battery.—Stephen Dahl, the electrician of the Pittsburgh, Allegheny & Manchester Passenger Railroad Company, is at work experimenting on a new storage battery system. It is said that the materials which Mr. Dahl will use in the construction of his apparatus are exceedingly light, and therefore well fitted for transportation in a street car.

Chattanooga, Tenn.—The electric street railway is pushing its lines toward the mountain and along the foot of Missionary Ridge, as well as to its top. Yankee visitors, it is said, find the hum of the electric motor much more to their liking than the hum of the musical "minnie" ball that once greeted them along the present track of the electric railway, and resident Confederates do not seem in such a hurry to get away as they were 25 years ago.

Will Adopt Double Deck Cars.—The Pleasant Valley street railway line of Pittsburgh, Pa., is about to adopt the double deck car which has long been used in the British metropolis and is so popular in that city. The Pleasant Valley people are fitting up one of the cars at their shops. In the interior will be seats for 42 passengers, the car being considerably longer than the regular car. On the top will be two long seats, placed back to back, extending the entire length of the car. These seats will accommodate 28 people. It is expected that the innovation will prove very satisfactory.

New Electric Railways in Pittsburgh, Pa.—Street car projects continue to spring up in great numbers in the city of Pittsburgh. At the last meeting of the city councils franchises for the operation of street railway lines were granted the following corporations: Pittsburgh and Mt. Lebanon Railway Company; KcKean Street Railway Company; Jane Street Railway Company; Arlington Avenue Railway Company; Bingham Street Railway Company. In each case it is proposed to employ electricity as the motive power. The sturdy, stubborn little quadruped known as the mule has ceased to be popular as a street car puller in Pittsburgh. He can't compete with Aleck Tricity, Esq.

An Electric Mountain Railway.—The Neversink Electric Mountain Railway has been completed. The route covers a distance of nine miles, circling about the summits of the mountains surrounding Reading. The success of the enterprise is assured. The cars will be run by electricity from Ninth and Penn streets to the White House, where they will be propelled by locomotive engines to the summit on the north side of the mountain. From this point the cars will drift down the mountain by the force of gravity to Klapperthal. On the return trip the cars will be drawn up to the summit on the south side, whence they will be run again to the White House by gravity, and thence by electricity to the starting point, Ninth and Penn streets.

Storage Battery Car at Providence, R. I.—The Providence *Journal* of a late date has an article descriptive of the trial trip of a storage battery car in that city, which was quite successful. The car is of the same pattern as those run at present on Fourth avenue, New York, and is very comfortable. Power is applied by two Thomson-Houston motors, and the car floor is one step above the platform. There are two iron folding gates at each end of the car. The car is lighted by six 16-candle incandescent lamps, and weighs seven tons with all its appurtenances. It was manufactured for the United Electric Traction Company, formerly the Julien Company, by the John Stephenson Company. The motors are 10-horse power each, and are wound for 250 volts. Underneath the seats on each side of the car there are six trays of cells and nine cells in each tray, making 54 cells on each side and 108 in the car. There are four degrees of speed that may be attained under the present construction of the car's machinery. No. 1 speed is obtained by connecting the 108 cells in four sets, in multiple, thus securing 54 volts. To obtain No. 2 speed with a pressure of 108 volts, the 108 cells are coupled together in halves. Speed No. 3, with 162 volts pressure, is secured by arranging three sets in multiple and one in series. No. 4 speed is obtained by having all the batteries connected in one series, giving 216 volts.

MISCELLANEOUS NOTES.

Mobile, Ala.—The Gamewell Fire Alarm Telegraph Company has been awarded the contract for the construction of a 20-box police telegraph alarm.

Chattanooga, Tenn.—J. A. Hart, S. R. Read, R. M. Barton, Jr., and others, have incorporated the Farrell Electric Heat, Steam and Light Company to operate an electric plant.

San Antonio, Tex.—Charles Guerguin, mayor pro tem., will receive proposals until July 19 for the purchase of five per cent. bonds to the amount of $25,000 to be expended in the construction of an electric fire alarm system.

The Waltham Electric Clock Company has been organized under the laws of New Hampshire with a capital of $110,000. The company is to locate in Natick, Mass., as all the officers with one exception are Natick people.

The Cataract Construction Company, Niagara Falls, N. Y., the engineer of which is Mr. Albert H. Porter, invites proposals from tunnel contractors for constructing the tunnel of 8,000 feet in length, and with a cross section of about 29 × 18 feet, to be built by the Niagara Falls Power Company.

Patent Office Interference Decided.—The interference case of Rudolph M. Hunter v. Fleeming Jenkin, declared some time ago in the United States Patent Office, has been argued, and the decision just rendered awards priority of invention for the telpherage system and series electric railway to Mr. Hunter. The invention is one which was transferred by the Union Electric Car Company of America to the Thomson-Houston Electric Company.

A Specimen Letter of Inquiry.—The secretary of one of the prominent electric motor companies in the East recently received the following letter of inquiry from a prospective western customer: . . . "I wish to run tools as follows in saw iron & wood lathes Borein & Mortising Planer & etc But not all ad at once and all of them on small scale Light work. N. B. We Have no Electric Light in this city if your Motors Dose not furnish its own current I would think it could not be successfully run here However write me what you think and what you can guarantee your Motors to do & oblige Yours Truly" * * *

A Fatal Accident.—At Lima, O., Edward Deubler was instantly killed on the evening of July 1, by an electric shock. According to the report of the Lima *Republican*, an arc light wire had sagged until it came in contact with a guy wire stretched between two poles and this guy, by means of a piece of loose wire hanging over it, was placed in metallic contact with the strap iron with which the pole was wrapped at its lower part. The unfortunate man received the shock which caused his death when, by leaning against the pole, he came in contact with the strap iron and completed the circuit between the arc light wire and the ground.

Construction of Electric Contract.—In an action to recover for an electric plant and the installation thereof where the contract was verbal, the defendant testified that he was to have an electric plant with a certain number of lights, for which he was to pay a fixed sum, and that he was to pay for wire and time in addition. Under a contract of this kind it does not follow as a conclusion of law that the purchaser must pay for putting the lights in place and for the necessary fixtures and appliances, as that must be determined by the jury from all the facts, in the absence of an express stipulation regarding that matter. This decision was rendered in the case of Muckle v. Moore, Supreme Court of Pennsylvania.

English Electricians have a Joke.—On the occasion of the post-office jubilee reception at the South Kensington Museum, in England, last week, it was announced that there would be an exhibition of a new invention, by which the person receiving a telephonic message would actually see in a mirror before him the reflection of the sender who was at the other end of the line. The invention was said to have been discovered by Prof. Hughes and Mr. W. H. Preece. To produce the promised result these two eminent gentlemen had simply arranged a series of mirrors, by which the image of the sender of the message was reflected to the mirror before the receiver. The scheme worked to perfection, and many newspaper men and others went away ready to swear that the problem of seeing through a brick wall had been solved. Both Mr. Preece and Prof. Hughes had the desired amount of merriment at the expense of the general public.

PERSONALS.

Mr. Ed. E. Richardson, of Chattanooga, Tenn., has resigned his position as secretary and treasurer of the D. M. Steward Manufacturing Company, of that place.

Mr. Alexander Wurts, one of the valued assistants of Mr. Shallenberger, electrician of the Westinghouse Electric Company, was married in Pittsburg on Monday, June 30th, to Miss Jeanie L. Childs. Mr. and Mrs. Wurts are at present enjoying a bridal journey.

Mr. John Dixon Gibbs, of the National Company for the distribution of electricity by secondary generators, of London, England, was a Pittsburg visitor last week. Mr. Gibbs was much impressed by the many wonderful things to be seen in that city of iron glass, natural gas and electricity.

Mr. George A. Redman, superintendent of the Brush Electric Light Company, of Rochester, N. Y., was recently thrown from his carriage while riding on the old woolen mill hill off North St. Paul street in that city, and fell a distance of about 25 feet. Fortunately he escaped without serious injury although quite severely bruised.

Mr. Charles H. Macloskie, superintendent of the electrical divisions of the West End Street Railway, Boston, was agreeably surprised one evening last week. A committee of three, represent-

ing the employés under his charge at the Allston, Cambridge, Grove Hall and Myrtle street car houses, called at Mr. Macloskie's residence, No. 137 West Chester Park, and presented him with a finely executed life-size crayon portrait of himself. The gift was accompanied with a few remarks by Mr. S. W. Childs, on behalf of the donors, and a signed testimonal from the men expressing their appreciation of Mr. Macloskie's consideration and friendliness, together with their well wishes for his continued prosperity.

Industrial and Trade Notes.

The American Electrical Works, of Providence, R. I., are building a new 40 by 120 addition to the factory.

The Armington & Sims Engine Company has just installed a number of its engines on the new government cruisers "Vesuvius" and 'Newark," furnishing power for the electrical plant.

The Pettingell-Andrews Company has secured the exclusive agency for New England and Eastern Canada for the Bryant switch and will commence business with a large stock on hand.

The Columbia Electric Company, St. Paul, is meeting with good success in the sale of its Beach arc lamp for alternating circuits and for other specialties, notably the Beach rosette cut-out and the Beach pat nt wood cleat.

The Novelty Electric Supply Company, 53 Coleman street, Cincinnati, received orders last month for 5,000 of its combination pole tops and for 10,000 trolley-wire hangers, as well as for 1,000 arc light windlasses and for many improved iron poles.

The Harris-Corliss Engine Company, of Providence, R. I., has in process of construction one of its celebrated compound engines for the Lowell Electric Light Company, Lowell, Mass., and two Independent 500 h. p. engines for the Missouri Street Railway Company, of St. Louis, Mo.

The Consolidated Temperature Controlling Company, Minneapolis, Minn., installed some 800 instruments during the six months just ended and is already entering up contracts for the coming season. The instrument has been found to be of special value on railway trains where it is very generally used.

The Fulton Foundry, 21 to 27 Furman street, Brooklyn, N. Y., has a reputation for making fine iron castings, especially adapted to electrical purposes, furnishing a strong but soft article, and turning them out just as represented. Complete pattern, machine and japan departments are connected with the establishment.

The Expanding Brass Wire Guards, introduced by the Central Electric Company, of Chicago, and adapted for use with the Sawyer-Man, Edison, Westinghouse, Thomson-Houston, and Schaefer sockets, without use of shade-holder, are a great protection to the lamp, especially when exposed, as in factories, warehouses, etc.

The D. M. Steward Manufacturing Company, of Chattanooga, Tenn., is still busy on orders for the patent lava insulators and is doing its best to keep up with the demands made by its customers. At a recent test where very high temperatures were necessary in close proximity to the insulators this material proved successful after the failure of asbestos.

The Central Electric Company has in its Chicago warehouse a complete stock of all sizes of the improved Candee weather-proof wire, ranging from No. 00 to No. 18. The number of large orders placed for this wire in the past few months are sufficient proofs of its merit. This company has recently received a very large consignment of soft rubber tubing of a high grade ranging in sizes from one-eighth to one inch in diameter.

Edwin L. Edes, successor to Oliver Edes & Son, manufacturers of battery zincs and coppers at Plymouth, Mass., has lately very much increased the capacity of his works, and is receiving some fine testimonials regarding the purity of his zincs, one sample recently tested in New York showing an almost absolutely pure zinc. The Anglo-American Telegraph and Cable Company indorses them highly, and a recent shipment of over 2,000 zincs was made to New York.

Electrical Draughtsmen will find that the ruler and section liner of Wm. Gardam & Son, 96 John street, New York city, possesses some valuable features which strongly commend it for use in hatching, cross-section work, plotting surveys, designing machinery and tools, and for photo-engraving process work, lithographic designing, in making flat tints, sky tints, and in graduated, curved, conical and cylindrical line work. Those who use it recommend it very highly.

Bradford, Kyle & Company, manufacturers of insulated electrical wire, at Plymouth, Mass., are covering wire by a patented process which secures a compact and uniform coating, firm adhesion and excellent insulation. The best of materials are used to produce a good product. Some of the largest electrical companies in the United States are now using the wire prepared by this firm. They make a specialty of cotton or silk-covered magnet wire, ranging in size from No. 16 to No. 40 B. & S. gauge.

The Bridgeport Machine Tool Works are receiving some very flattering orders for their tools. Among others they have in process of construction a large number of tools for the new shops of the Edison Machine Works of Schenectady; also tools for the new works of the Wenstrom Consolidated Dynamo and Motor Company, at Baltimore, Md. They have also just made a large shipment to the Thomson-Houston Electric Company, and the prospects for the rest of the year are excellent.

The Boston Rubber Shoe Company is doing a nice business with electrical people in the sale of the celebrated "Climax" tape, which has earned for itself such a high position as an insulating covering during the last ten years, in which time it has been on the market. This tape is practically the material which is used by this company in its regular business, and, being the largest manufacturer of rubber boots and shoes in the world, the company is able to supply from its own regular products a superior article.

The Wm. Powell Company, 50 to 54 Plum street, Cincinnati, O., is placing upon the market some very useful dynamo oilers, known as the double and triple sight-feed cups. In these the flow of the oil can be instantly stopped or started without changing the set of the feed. The quantity is regulated by thumb screw independent of signal lever. The sight chamber is fitted with square window panes which can be removed for inspection, cleaning or repairs, at any time without stopping the flow of oil and while the machine is running.

The Benedict & Burnham Manufacturing Company, 13 Murray street, New York city, has issued a neatly printed and artistic little pamphlet giving price lists of its insulated and bare wires and cables for electrical purposes. It also contains valuable data of the dimensions, weights, resistances, etc., of various kinds of wires and copper bars. Mr. W. A. Hungerford reports an unusually active demand for the electric light line wire known as the "F & W," which is both fire and weather proof. This wire is first double braided and saturated with a fire-proof material, then braided again and finished with a black weather-proof substance. It is highly endorsed by those who have used it.

The Thomson-Houston Electric Company, through its Chicago office, reports the following sales for the month of June: Capitol Electric Company, Nashville, Tenn., 7 motors, from ¼ h. p. to 50 h. p.; Mt. Clemens Electric Company, Mt. Clemens, Mich., 650-light alternating incandescent; Salt Lake Power, Light and Heating Company, Salt Lake City, Utah, 170 arcs; Atchison Gas and Electric Light Company, Atchison, Kan., 650 light alternating incandescent; B. Nugent & Bro., St. Louis, Mo., 1 h. p. motor; Logan Light, Power and Heating Company, Logan, Utah, 650-light alternating incandescent; Gogebic Electric Company, Bessemer, Mich., 1,950 alternating incandescents; Dodge Manufacturing Company, Mishawaka, Ind., 650 alternating incandescents; Inter-Ocean Publishing Company, Chicago, Ill., two motors; Capitol Electric Company, Nashville, Tenn., 350 arcs; Huntington Cotton Manufacturing Company, Huntington, Ark., 750 direct incandescents.

The Germantown Electrical Company is doing a large construction business in Philadelphia and Germantown, and is now at work on the new apartment house of Mr. W. G. Warden, Philadelphia, in which the Interior Conduit and Insulation Company's conduit system is being installed. This will be the first building in the city of Philadelphia to have the conduit system complete as a system, and Mr. A. J. Martin, who is general superintendent of the Germantown Electrical Company, is giving this installation his personal supervision, and intends to make it "second to none" in conduiting and wiring. He will use about 50,000 feet of conduit. When the installation is complete the building will have about 2,500 incandescent lights. Mr. A. J. Martin has also closed for the Germantown Electrical Company contracts for 25 houses in Germantown, two of which will be electrically conduited, and in the others the tubing will be used in part. Two bank buildings will be equipped with the conduit system by this company, on which work will be commenced in about two or three weeks.

The Great Western Electric Supply Company, 190 and 192 Fifth avenue, Chicago, is gradually having its storerooms filled with everything requisite for the construction, operation and maintenance of electric light, power, mining and railway plants, as well as for telephone, telegraph, messenger and house alarm service, and Manager Cutter and his chief assistant, Mr. H. R. Hixson, find their time fully occupied in taking care of the business that is steadily coming in to them, much of which is sent by friends made during the past eighteen months, and who have not only appreciated the value of Mr. Cutter's practical experience in heavy construction work, but have also treasured up the practical advice regarding the installation and care of electrical machinery so generously tendered at all times. Few men have had the excellent opportunities afforded Mr. Cutter for making a thorough investigation of all the various electrical systems in use both in this country and in Europe, and for forming the acquaintance of so many electricians of note, as, prior to his venture in commercial life, Mr. Cutter spent some four years in Europe promoting the interests of the Thomson-Houston Electric Company. The display of its apparatus at the Inventors' Exhibition, in London, in 1885, was installed by Mr. Cutter, and during the six months he remained in charge of the exhibit not a Thomson-Houston light was reported out—the only system having a clean record, according to the official reports. From London Mr. Cutter went to Brussels, having been appointed chief engineer of the Thomson-Houston International Electric Company, and during the next two years made repeated trips through France, Italy, Spain, Switzerand, Russia, Norway, Finland, Sweden and Germany, the trip through the land of the midnight sun in the month of June, 1887, being especially memorable. During these trips Mr. Cutter prepared nearly all the estimates for the European office, among the larger being that for a complete electric light plant with underground mains in Madrid, the total cost of which exceeded $100,000, and a municipal plant in St. Petersburg using artistic iron poles and underground circuits and estimated to cost $66,000. Other plants were projected at Palermo, Turin, Rome, Milan, Lubeck, Metz, Nijni-Novgorod; while the first plant sold by Mr. Cutter was installed in Milan, Italy, which city is almost entirely lighted now by Thomson-Houston lamps.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest. All inquiries must be accompanied by real name and address, as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Self-Induction.—Would you kindly explain if phenomenon which I noticed in an Edison shunt-wound 300-light dynamo, with connection as usual, field and headlight connected ahead of main switch, allowing speed sufficient to bring lights down to dull red, first opened the main switch leaving the headlight in circuit, then on breaking circuit by taking off brushes headlight lit up to bright white for about two seconds and then went out. I am aware that on breaking any circuit self-induction takes place, but cannot see how that will affect the lamp under given conditions.

SUBSCRIBER.

The sudden lighting up of the lamp was apparently due to the extra current caused by self-induction in the magnetic fields on breaking the circuit at the brushes. Field magnets and lamp form a complete circuit together when the brushes are removed.

Induction Coil.—Please inform me where I can get information as to obtaining a continuous current from the alternating current of an induction coil. The matter is referred to, but only very briefly, by a correspondent in your issue of March 8.

WM. HARTGRAVE.

In THE ELECTRICAL WORLD of Nov. 2, 1889, pages 290 and 294, and Nov. 23, 1889, page 338, you will find elaborate papers on this subject The first gives the method of Mr. Tesla, the second is by Mr. A. Gaillard, and in the third Mr. E. E. Ries discusses Mr. Tesla's devices.

A Voltmeter in Trouble.—I am running a small Edison plant. The voltmeter is out of order and will not register. Whichever side I connect the positive wire to, the pointer goes to it and remains. Can you tell me what is the probable difficulty?

T. H., Pernambuco.

It is rather difficult to assign the exact cause of your difficulty without knowing what kind of voltmeter you used. If it is an instrument in which the action of the current is opposed by a permanent magnet, we should say that that magnet had lost its strength from a current being passed around the coils in the wrong direction. In general it appears that whatever is employed to resist displacement of the moving parts of the instrument has lost its strength, and the voltmeter will not be of service to you until repaired and recalibrated.

Wiring for Arc Lights.—Can you give me the best met hod of wiring a town for lighting the streets with arc lamps where the streets are lined on each side with trees? Some of these are too high to run over and some of them in same street too low to fasten the wires to. Is there any wire, which is not too expensive, which will stand being run through trees, and is not a better way running a wire in the middle of the street than suspending it from cables stretched across? J. H. S.

We do not think that the public would take kindly to having an arc wire suspended above the street in the way you mention. Would advise you to use poles and run the wire as clear of trees as careful placing of the supports will allow. An occasional long cross-arm may relieve you of some embarrassment. There are various wires in the market which will stand being run through trees, provided they are not frayed by the swaying of the branches. In a place exposed to such wear the wire should have an extra sheathing and be carefully watched.

Electric Fire Engines.—Could electricity be used in place of steam in the fire departments of large cities? In such case an electric pump would be substituted for the ordinary fire engine, there would be no fuel to be carried, the engine would be lighter and less clumsy, and could reach the fire sooner. The wires conveying the current from the central station might run under the ground to water plugs, and in case of fire would only take a few minutes to get connected at plugs. Would you advise if such a scheme has been tried, and also as to possibility and practicability? W. P. R.

A very similar suggestion to your own came to us from Boston a few days ago. The principal objection to such an arrangement appears to us to be the danger that always comes from depending on one source of power. A fire engine is an independent unit, whereas any such arrangement as you suggest would depend on everything being ready at the central power station, and if a fire happened to break out there the fire department would be seriously crippled. Such electric fire engines might be a useful adjunct to the present system, however, as they certainly would be lighter and more convenient in many ways. It would hardly do, however, to rely entirely upon a system so easily crippled by damage occurring at a single point.

Business Notices.

Steam Pipe and Boiler Coverings.—The H. W. John's Manufacturing Company, 87 Maiden Lane, N. Y., make a specialty of applying their coverings in any part of the United States. Send for estimates.

The Battery Cut-Out sold by the Electric Supply Company, of Syracuse, N. Y., 105 South Warren street, is cheap. Thoroughly tested, it is giving complete satisfaction. It automatically prevents the short-circuiting and damaging of gas lighting and other batteries. Send for circular.

THE FIBRONE MANUFACTURING COMPANY, NEW YORK:

GENTLEMEN.—We have made an exhaustive examination of the sample of FIBRONE submitted to us, and to-day, with a perfect knowledge of the value of your FIBRONE for electrical uses, we do not hesitate in fully endorsing it as a substitute for hard rubber.

MERCHANTS' AND MANUFACTURERS' NATIONAL LABORATORY,
NEW YORK, May 22, 1890. 52 Broad St., New York.

Through Vestibuled and Colonist Sleepers Between Chicago and Tacoma, Wash., and Portland, Ore.—The Wisconsin Central and Northern Pacific lines run through Pullman vestibuled and colonist sleepers between Chicago and Tacoma, Wash., and Portland, Ore. The train known as the "Pacific Express" leaves the Grand Central Passenger Station, at the corner of Fifth avenue and Harrison street, at 10:45 P. M. daily. For tickets, berths in Pullman or colonist sleepers, etc., apply to Geo. K. Thompson, city passenger and ticket agent, 205 Clark street, or to F. J. Eddy, depot ticket agent, Grand Central Passenger Station, corner Fifth avenue and Harrison street, Chicago, Ill.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. Patents Issued July 1, 1890.

431,035. Electric Cut-Out; Leo Daft, of Plainfield, N. J., assignor to the Daft Electric Light Company, of New York, N. Y. Application filed Oct. 16, 1885. The combination, with a circuit breaker pivotally secured at one end and engaging with the terminals, of a magnet in the circuit having one of its poles extended, a lever pivotally secured in the extension and provided at one end with a lip for engaging with the circuit breaker and having a dash pot at the other end, a magnet in the circuit for operating the lever, and a spring between the lever and the magnet, and an adjusting screw in the lever intermediate its pivotal point and the dash pot, one end of which engages with the spring.

431,038. Ceiling Block Connecter for Incandescent Lamps; Louis W. Dillon, of North Attleborough, Assignor of one-half to Homer M. Daggett, Jr., of Attleborough, Mass. Application filed August 26, 1889. The combination of the base having a central depression and main wire clamps with inward extensions, the cap having a central projection to engage with the central depression of the base, the projection having passages for the wires of the supplied branch below the portion that enters the depression of the base, and said cap having fastening and connecting pieces that engage with the main wire clamps by a slight rotary movement of the cap relative to the base.

431,062. Fuse-Block; James L. Kimball and Herbert C. Wirt, of Boston, Mass. Application filed Dec. 6, 1889. In an electric cut-out, the combination, with a base provided with two sets of contact pieces of a removable cap, having two sets of contact arms secured to it and each set extended beyond the said cap on its opposite sides, fusible connections joining the contact arms on the cap and forming part of main or branch lines and means to secure the said contact arms to the base outside the cap.

431,073. Electric Battery; Myron W. Parrish, of Detroit Mich., Assignor by direct and mesne assignments to Junias A. Bowden and the Graphite Electric Company, of same place, and John Hutchinson, of Jackson, Mich. Application filed Dec. 2, 1889. An electrode for a voltaic battery which consists of an irregular piece or mass of graphite in its crude state as it comes from the mine.

431,088. Individual Call for Telephones; Charles H. Vincent, of Lynn, Mass., Assignor to Frederick W. A. Bergengren, of same place, and John V. Spaulding, of Boston, Mass. Application filed Aug. 2, 1889. In an individual call system, the combination of an electromagnet, an armature, hammer and bell, the arm to which the armature is connected, an electrode or con-

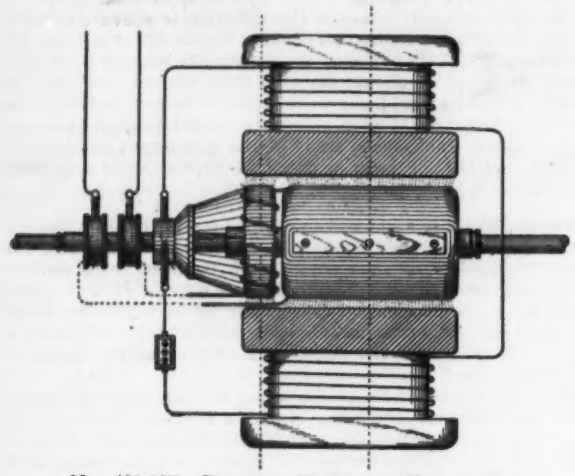
tact which co-operates with the said arm, and a weighted lever connected to the arm.

431,092. System of Electric Locomotion; Frank Wheeler, of Meriden, Conn. Application filed March 2, 1889. A conducting wire, an arched insulating cover supported by it, and a series of hangers depending from it and carrying two trolley track wires; also a special trolley for this system. See page 24, this issue.

(1) 431,093. (3) 431,095. System of Electric Locomotion. (2) 431,094. Switch for Electric Railway Systems; Frank Wheeler, of Meriden, Conn. Applications filed (1) March 27, 1889. (2) Dec. 3, 1889. (3) Dec. 8, 1889. (1) A tubular conductor having a longitudinal opening, the edges of the conductor each side of the opening being curved inwardly and upwardly to form concave tracks for a trolley. (2) The combination with a track switch and an overhead conductor switch, of connections whereby operation of one switch will simultaneously operate the other. (3) A switch for turn-out conductors, consisting of a frame and a switch track pivoted in the frame and extending in two directions from the pivot. See page 24, this issue.

431,118. Electric Switch; Osborn P. Loomis, of Somerville, Mass., Assignor to the Loomis Electric Manufacturing Company, of New York, N. Y. Application filed Sept. 3, 1888. In an electric switch, the combination, with a pivoted switch arm carrying contacts and provided with a pin, the terminals engaged by the contacts of a coil spring made fast by one end, and having the other end bent to engage the pin on the switch arm, the movement of which latter in one direction tends to wind the spring and make it tense, the said spring exerting its pressure upon the side of the pin removed from the pivotal centre of the arm when the latter is in closed position.

431,134. Dynamo Electric Machine; Chas. F. Winkler, of Troy, N. Y. Application filed Sept. 16, 1889. An armature for



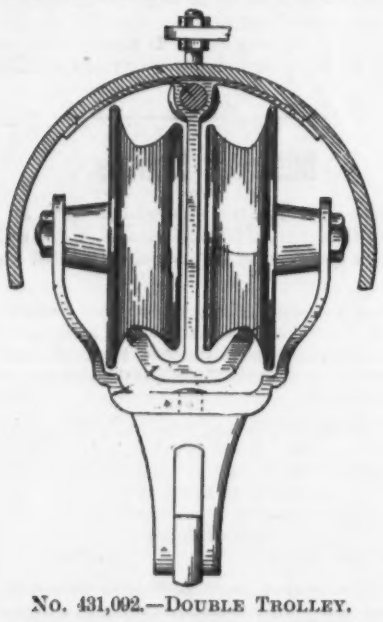
No. 431,025.—Dynamo Electric Machine.

dynamo electric machines carrying two separate circuits, one of which is wound entirely inside or underneath the other, thereby locating it more or less remote from the periphery of the armature and correspondingly affecting the electromotive force induced therein.

431,141. Electrical Call-Box; George F. Gale, of Winthrop, Assignor of one-half to Arnold B. Holmes, of Boston, Mass. Application filed Feb. 27, 1890. In an escapement mechanism, the combination of a double toothed click pivoted to a fixed plate or support, a reciprocating main gear, a pivoted lever, a ratchet and pinion journaled on the lever, the pinion meshing with the gear and the ratchet being disposed in position to engage the click when the gear reciprocates.

431,170. Electro-Magnetic Drill System; Harry N. Marvin, of Syracuse, N. Y., Assignor to the Marvin Electric Drill Company, of same place. Application filed Dec. 17, 1889. The combination, with the armature coil and commutator, of a direct or continuous current dynamo machine and a field exciting circuit supplied with direct currents therefrom, of two independent circuits and collectors in connection with opposite points of the armature coil and adapted to connect said coil alternately with the two circuits.

431,181. Electric Bell; Patrick B. Delaney, of South Orange, N. J. Application filed March 17, 1890. The combination of an



No. 431,092.—Double Trolley.

electric bell and a spring arm pivoted eccentrically of the axis or supporting post of the bell to muffle its sound.

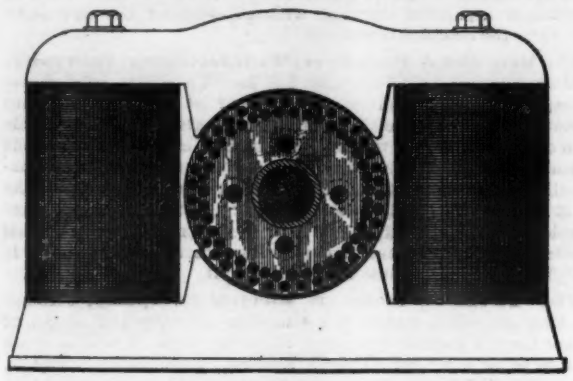
431,186. Multiple Thermal Cut-out; Lorenzo B. Favor, of Bridgeport, Conn., Assignor to the Thermal Electric Company, of Maine. Application filed April 14, 1890. In an electrical thermal cut-out the combination with the non-conducting base the conducting bar secured thereto, the pivoted conducting levers insulated from each other, the fusible conducting wires connecting the bar and levers, and the spring actuated pawl adapted to normally engage the levers the ends of the line wires being in connection, respectively, with the bar and pawl.

431,216. Regulation of Dynamo Electric Machines; William Stanley, Jr., of Great Barrington, Mass. Application filed July 29, 1889. The method of generating and regulating electric currents, which consists in generating currents in a set of armature coils and maintaining a field of force thereby, causing a portion of the lines of force constituting such field to pass outside of such coils and controlling the number of the lines of force passing outside of such coils by means of current developed in a second set of armature coils lying within such field.

431,217. Self-Regulating Dynamo Electric Generator; William Stanley, Jr., of Great Barrington, Mass. Application filed Sept. 23, 1889. In a self-exciting electric current generator the combination of two independent sets of armature coils lying within the same field of force, the one supplying current to the field magnet coils and the other to the working circuit, and regulating coils applied to the first named set of armature coils and wound upon the same core therewith and in circuit with the armature coils which supply current to the work circuit.

431,218. Self-Exciting Alternating Current Electric Generator; William Stanley, Jr., of Great Barrington, Mass. Application filed July 29, 1889. In a self exciting alternate current electric generator, the combination with two independent sets of armature coils, the one set supplying current to the work circuit and the other supplying current to excite the field magnets of the generator, and a path for a portion of the lines of force of the magnetic field of the generator through the armature core outside of the coils composing the second set.

431,235. Dynamo Electric Machines; Oliver B. Schallenberger, of Rochester, Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed Jan. 24, 1889. The combination, with the field magnet, of an electrical generator and an armature adapted to revolve within the field of force established by currents delivered by its coils, of a second armature delivering



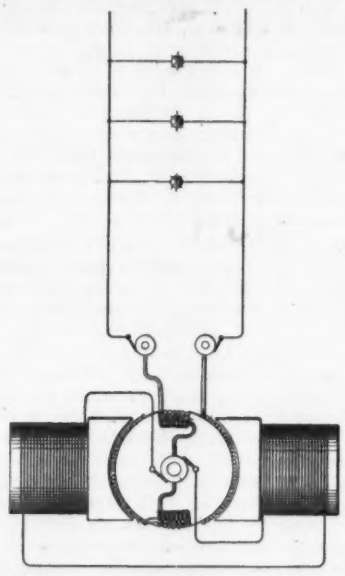
No. 431,134.—Dynamo.

currents to a work circuit, and a second coil applied to the first named armature and connected in series with the coils of the second armature.

431,248. Electric Meter; Jules Cauderay, of Paris, France. Application filed Aug. 17, 1889. The invention consists of a cam shaped or eccentric plate or bar controlled as to its position by an amperemeter, or equivalent measuring device and extending into or across the path of an arm or lever carrying a dog or pawl which gives motion to the ractchet wheel, through which the register train first receives motion.

431,256. Suspended Electric Railway and Car; Frederick Eugene Brown, of Pawtucket, R. I. Application filed April 6, 1889. In a suspended electric railway system, a railway track consisting of a tube, suspended from a deflected cable by ties, the said tube having in its bottom side a longitudinal opening, slot extending from end to end.

431,271. High and Low Water Alarm for Steam Boilers; James McFarlane, of Malden, Mass. Application filed March 5, 1890. A water gauge tube provided with a branch tube, a float



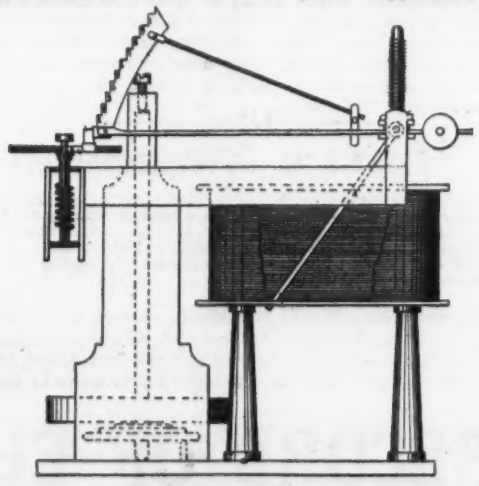
No. 431,217.—Self-Regulating Dynamo.

arranged in the latter, and a rod fixed to a float provided with prongs and adapted to slide in the cap of the branch tube combined with the poles of the electric circuits arranged with the prongs.

431,320. Electric Lamp Fixture; Sigmund Bergmann, of New York, N. Y. Application filed March 3, 1890. In an electric lamp fixture, the combination, with a tubular portion thereof, of a seat for a cut out consisting of a frame or ring formed in the tubular portion, having transverse channels to prevent the cut out from turning, and open at the sides.

431,341. Secondary Battery; Theo. M. Foote, of Allston, Assignor of one-half to Charles J. Pillsbury, of Boston, Mass. Application filed July 5, 1889. In a storage battery, an electrode, consisting of a tube of lead or other suitable metal filed with a powder composed of the material which is acted upon by the charging current, provided with perforations upon its sides, folded vertically upon itself, and having adjacent folds united by "burning" at points near the top and bottom of each fold.

431,408. Electric Railway Signal Apparatus; William Snee, of Pittsburgh, Pa., Assignor of seven-eighths to John A. Snee and Anson P. Norton, of same place. Application filed



No. 431,248.—Electric Meter.

March 4, 1890. In electric signaling apparatus for block system railways the combination, with two sets of magnets, located at each end of a block section and electrically connected together, of positive and negative conductors located in proximity to the tracks, rail sections on one side of the track connected to the positive conductor, opposite rail sections breaking joints therewith, connected with the magnets, armatures operating the signaling mechanism located between each set of electro-magnets, and a cut-off for making and breaking connection between one of the magnets of set and its corresponding rail section.

431,412. Electric Connector; Hermann Studte, of Dom Kruk near Inowraclaw, Prussia, Ger. Application filed Nov. 29, 1889. On combination with a spring mounted contact cap, a spring mounted ring surrounding the cap and a corresponding cap and ring adapted to cover the first cap and ring.

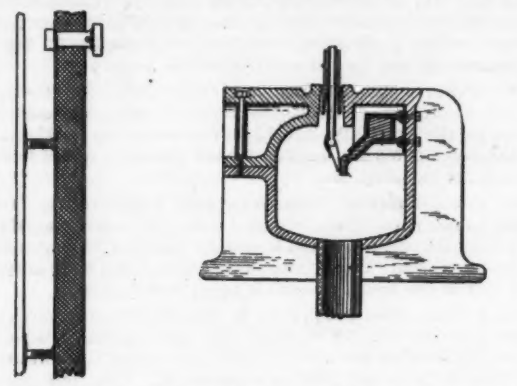
431,414. Electric Railway Conductor; Elihu Thomson, of Lynn, Mass. Application filed March 22, 1890. The invention consists in forming the feeding conductor for the current, insulating the same, and establishing branch connection at intervals therefrom, which support the bare conductor traversed by the contact device, while the insulated conductor is in turn supported at the points distinct from those portions of its length which support the bare conductor.

431,439. Electric Soldering Iron; Charles L. Coffin, of Detroit, Mich. Application filed Jan 18, 1890. A soldering iron consisting of a hollow head, a conductor of high resistance in the head and having its ends adapted to be connected with the poles of a generator of electricity, and a lining of refractory non-conducting material inclosing the circuit within the head, an opening at the point of the tool, and a valve for controlling the opening, whereby the interior of the tool is adapted as a reservoir for melted solder.

431,447. Secondary Battery; T. S. E. Dixon, of Chicago, Ill. Application filed Feb. 6, 1890. As an improvement in electric batteries, a secondary battery cell provided with two or more charged plates and one or more supplementary plates differing in their respective electromotive potentials.

431,460. System of Electrical Distribution; Ludwig Gutman, of Fort Wayne, Ind. Application filed Jan. 25, 1889. In a system of alternating current distribution, the combination of an electric converter, a cord, a primary coil, and a secondary coil for the converter, translating devices in a circuit with the secondary coil of the converter, an additional coil mounted on the converter's core independent of the converter's coil and means, such as a switch, for including said additional coin in circuit with one of the converter's coils.

431,492. Reciprocating Electric Engine; Charles J. Van Depoele, of Lynn, Mass. Application filed April 3, 1890. In a reciprocating electric engine, a shifting field of force an iron plunger



No. 431,414.—Electric Railway Conductor.

actuated by the field of force and means for varying the magnetic relation between the shifting field of force and the plunger.

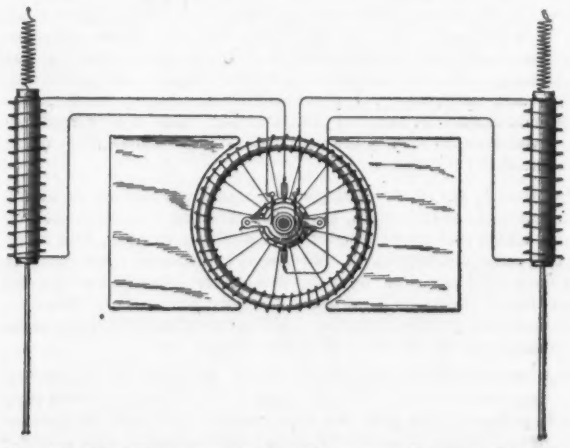
431,493. Reciprocating Electric Engine; Charles J. Van Depoele, of Lynn, Mass. Application filed April 3, 1890. In a reciprocating electric engine, the combination, with a motor, coil or coils, of a magnetic piston adapted to be reciprocated therein and a magnetic extension upon the piston for causing the piston to move with greater force in one direction than in the other.

431,494. Reciprocating Electric Engine System; Chas. J. Van Depoele, of Lynn, Mass. Application filed April 17, 1890. The method of operating reciprocating electric engines having a plurality of motor coils and a magnetic piston adapted to be reciprocated therethrough, which consists in supplying a continuous electric current to the terminals of the motor coils and causing the current to rise in one coil while falling in the other, thereby transferring the magnetic field from one set of coils to the other, and vice versa, without interruption.

431,495. Reciprocating Electric Engine; Charles J. Van Depoele, of Lynn, Mass. Application filed April 18, 1890. A reciprocating electro-magnetic engine having constantly energized motor coils and a supplementary coil or coils in which the current alternately rises and falls, the combined coils reacting upon and imparting reciprocating motion to a magnetic piston movable therein.

431,496. Reciprocating Electric Engine System; C. J. Van Poele, of Lynn, Mass. Application filed April 18, 1890. The combination with the sectional commutator and stationary brushes of a continuous current machine, of a pair of contact carrying arms radially mounted with respect to the commutator and adapted to be moved coincidently on opposite sides of the commutator between the fixed brushes.

431,516. Automatic Cut-Out; Alvin Z. Haines, of Pittsburgh, and James H. Curry, of Wilkinsburg, Assignors of one-



No. 431,494.—Reciprocating Electric Engine System.

eighth to Walter A. Rose, of Rochester, and Marshall D. McWhinney, of Wilkinsburg, Pa. Application filed May 23, 1890. The combination, with an overhead conductor consisting of a series of sections, of buttons or heads formed on the ends of the sections, a case or shell inclosing the buttons, and springs adapted when free to act to force the buttons out of contact with the case or shell.

431,519. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed April 23, 1890. In an electric railway, the combination of the main line conductors, branch conductors opening into the line conductors and receiving current from the same source, with two switching conductors hinged in line with the main line conductors and pointing toward the branching point.

431,531. Telephone Signal Apparatus; John A. Seely, of Brooklyn, N. Y., Assignor to the Western Electric Company of Chicago, Ill. Application filed January 21, 1888. The invention consists in using doubly wound clearing out annunciators in the metallic circuits, so connected that the current sent over either limb or both limbs of the metallic circuit will operate the clearing out annunciators while current sent over the limbs when connected in metallic circuit and disconnected from ground will not operate, or in anywise affect the clearing out annunciators, the coils of the clearing out annunciators being neutrally disposed with respect to the two limbs when connected in metallic circuit for talking purposes.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

GREAT WESTERN ELECTRIC SUPPLY COMPANY

190 & 192 FIFTH AVENUE, CHICAGO.

THE DENVER CONSOLIDATED ELECTRIC COMPANY,

General Office: 1,534 LAWRENCE STREET,

DENVER, COL., June 26, 1890.

MR. GEORGE CUTTER, Manager,
Great Western Electric Supply Co., Fifth avenue, Chicago.

Dear Sir: Samples of SIMPLEX WIRE have arrived. Have had No. 6 in bucket of water, with bucket connected to one side of Brush Dynamo and wire to other side, and nothing but insulation to prevent short-circuiting a potential of 2,208 VOLTS, for OVER 50 HOURS, and it is as good as ever yet, and apparently good for a long time. The OTHER WIRE tested gave out under same test in 1 HOUR 40 MINUTES, and it is an expensive wire, too. [Signed] H. BOTTOMLEY.

This talks better than the order for 1,000,000 feet, which we refused because the price offered was less than the cost of making a reliable Insulation.

WE WILL NOT LOWER
THE QUALITY OF SIMPLEX WIRE.

SPRAGUE ELECTRIC RAILWAY SYSTEM.

More than 100 different Street Railways in operation or in course of construction.

More than 175 separate orders from Street Railways for Electrical Equipments.

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Sprague Electric Railway and Motor Co.,

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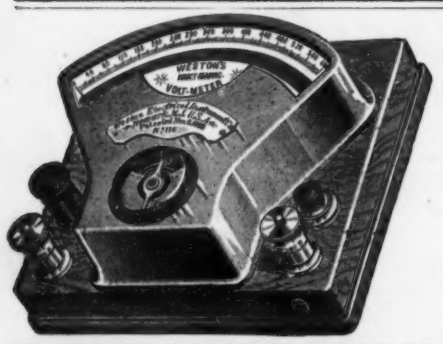

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